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ADDRESS AT THE ANNUAL GENERAL MEETING

of the Society held on 19 June 1933, by the President

ADMIRAL SIR WILLIAM GOODENOUGH, G.C.B.

MUCH admirable work has been done in the last twelve months in all branches of those activities which we profess in the Society. First, I will speak shortly of the journeys to little-known countries. Mr. Odell took part in the Forbes Expedition to Labrador, and the account which he gave of the country, together with the photographs, were of great value. The cartographic results of that expedition are now in the hands of Mr. Miller, a pupil of Mr. Reeves. I will refer a little later to the encouragement which the air photographs have given to the proper use of air survey.

Miss Cheesman did some quite admirable work in the Island of Malakula. Her principal occupation is entomology, and during the prosecution of that work she was able to make some more strictly geographical research by which we have benefited.

The Cambridge Expedition to Vatnajökull produced a well-written paper, giving an account of an interesting country which is still comparatively unknown, and as a contrast I would mention the Oxford Exploration Club's expedition to Sarawak, a brilliant account of which was given only a week ago by Mr. Harrisson.

I would at this juncture commend with admiration the efforts which are being made by young men and, in other circumstances, young women in geographical research of all kinds. May I assure them that this Society will be ever sympathetic towards their endeavours. If, from time to time, we seem to place a check on the ardour which they would display in placing themselves in positions of difficulty and danger, as indeed they should wish to do, I beg them to remember that it is in their own interests. Some experience, especially in Polar exploration, is required. We consider, I think rightly, that the experience which we have in this Society allows us to suggest from time to time that they should walk before they attempt to run. I would point out that many other expeditions of a similar nature are preparing to go somewhere: the Army, the Navy, the Universities, and other independent parties all have something in hand. I would like to call attention to an adventurous journey which is being taken by five of my own brother officers who started from

Hong Kong in a small ketch about a week ago on an eight-months' journey from that port to England *via* Japan, the Aleutian Islands, and Galapagos.

We have had the opportunity of welcoming this year many from abroad. Prince Sixte de Bourbon added to our interest in dealing with the great routes in the Sahara, and we would willingly hear in greater detail of what those routes were in the past and may become in the future.

The lecture by Captain Ejnar Mikkelsen on the Blosseville Coast was of particular interest. I may be allowed to say that it is a matter of great pleasure to all to know that questions in Greenland have now been settled to the satisfaction of all parties. Captain Mikkelsen is one of those who devotes his energy, time, and means to the cause of his country's determined efforts to ameliorate the conditions of the Eskimo, and with great sincerity we wish him and all those who are employed on similar quests in whatever country all success.

Monsieur Delacour's paper on the "Civilizations of Indo-China" marked, I hope, the breadth of our views of historical geography.

Once again Sir Douglas Mawson has added to our geographical knowledge in Southern regions. The paper which he read on Kerguelen displayed all his well-known thoroughness in every respect; and here again I would call attention to his use of the aeroplane for adding to geographical knowledge and survey. Sir Douglas Mawson travelled with a document signed by His Majesty authorizing him to annexe certain territories to the British Empire, and the recent proclamation on that subject is an actual sequel to the expedition. We hope that Australia will now make some definite effort to utilize this territory or, at any rate, to investigate it. Scientific research has now been recognized as evidence of effective occupation.

Mr. Murray Walton's description of mountaineering in Formosa showed us how a country with progress at heart—I refer to Japan—can meet with real success.

Professor Gregory's death prevented us from hearing from him himself a description of his work in Peru, but the very good account given by Mr. Coverley-Price and Miss McKinnon Wood deserves special mention. Mr. Coverley-Price's really delightful pictures are about to be exhibited here and will be well worth a visit.

One of the features of the year was Major Bagnold's journey to the South-West Libyan desert, a paper on which was read by Mr. Shaw. It is one of the best examples of combining the various and varied activities we profess—physical, those of natural history, archaeology, and the like. We gained very valuable information on the art of desert travel by car. It is interesting to note that this expedition was in the field for three months and its total cost was about £1000.

In speaking of the Libyan Desert I would mention that Lady Clayton has been working with Mr. P. A. Clayton very successfully round the Gilf Kebir.

As last year, I would call attention to the importance and interest of our afternoon meetings. The visit of Dr. Sorge to describe the results of the Wegener Expedition to Greenland was most useful. That and the Watkins Expedition formed admirable contrasts. The Germans on this occasion were more seriously scientific in their investigation of glaciology than was the

Watkins Expedition, and the Englishmen covered a good deal more country with success. The discussion with Dr. Sorge was most valuable to us and to all who are trying the new seismograph sounding on ice thickness. An instrument, as you know, has been constructed to determine these ice thicknesses. One trial has been made and much experimental work will be required before the instrument gives us the results we hope for. Work has been done by the Geophysical Department at Cambridge this year to get the instrument properly working, and it is now going to Spitsbergen with the Oxford party, but several seasons' work in varied conditions will be necessary before one can get the method into full working order.

Dr. Spencer's paper on "Meteorite Craters as Topographical Features on the Earth's Surface" was very important. This subject, with reference to its effect on the Earth's surface, will be pursued.

We had an interesting meeting in which Brig.-Gen. Winterbotham explained to us the National Grid. There are those who regard the National Grid in cartography as a matter of the first importance and believe that the idea will develop rapidly. If this National Grid is to be made use of, the first people to enlist in sympathy are the teachers in all schools—primary, secondary, public, and private. I do not go so far as to say that we shall see the co-ordinates as shown on the grid printed on our writing-paper, but in field work it is a great addition to ease in map-reading, and I hope that all those connected with the teaching profession will give attention to it.

There is one more remark I would make with regard to our afternoon lectures. We are most anxious that it should be known throughout all schools, colleges, and places of learning and education that this Society is in the greatest possible sympathy with what is called the New Geography. I have said before, and I say now, that if the human element were eliminated from geographical matters its interest and importance would largely disappear. I will not repeat what I said two years ago on the subject of finding places for the surplus population of older countries to go to, especially as I propose to speak of it this evening, but investigation of the habitable globe is to my mind one of the most important, if not the most important, of our efforts, and I hope that young men and women will press us to consider papers on any subject of human and regional geography, and will not be deterred from continuing to press us if time and space only admit of our accepting a few papers.

Of somewhat lighter but very fascinating matters I would call attention to the films which are shown from time to time. One in particular given last year on the Hadhramaut gave one some idea of a country still hardly known, and we hope next year that these films will become more and more popular.

I said just now that I would speak of air survey. I am indebted to Admiral Douglas for some remarks on how air survey should be of value to the hydrographical surveyor. Some of us believe that that value has not been sufficiently realized. A good example that may be given is the coast of Labrador, where one of His Majesty's surveying vessels is now engaged. This coast-line, dotted with islands and rocks almost innumerable, is bound to take many years to chart, but the completion could be much hastened if an air survey of the coast and islands, the survey being controlled by ships' triangulation, were made. It is quite true that the location of shoals and other under-water features could

not be made from the air, but the air survey of the coast would allow the surveyor to concentrate more on the purely hydrographical work and so hasten its completion. Those who know Labrador have great expectations that when once the country is opened up, it will prove of no little economic value to the Empire in timber, minerals, and other natural resources, but until the surveys are made such development must be seriously handicapped.

Professor Mason is so kind as to help me with some remarks on air survey in connection with ground survey. Much investigation is still required to bring these two methods together. The enthusiast no doubt believes that air survey can replace ground survey entirely, that all the air surveyor has to do is to take some photographs, plot a map and trace the details from the photographs. That is not so. Accurate aeroplane surveys are still dependent on a carefully observed ground control. A framework of points observed by instruments at fixed stations on the ground is necessary. Where the ground control is good, the ground flown over fairly level, the air calm, and the pilot able to fly at a constant level, air photographs are of great value for filling in the topographical features on the map. Where any of these conditions are absent many difficulties arise, and it may well be that the labour of rectifying and adjusting the photographs to make them true to scale becomes so great and the plotting so costly that it becomes more advantageous to carry out the greater part of the survey from the ground. Probably the most efficient method of producing a modern accurate map of mountainous country is by a combination of ground and air photography. The recent flight over Mount Everest and other mountains and the photographs obtained from them will be of great use in the identification of certain peaks. Some may have been surprised that these have not been heretofore noticed in our *Journal*. The reasons are that we have been anxious to make a complete and proper investigation into these matters. Those occupied in the flight have been working with our staff here, and it is hoped that an accurate and scientific description will result.

I have made no mention of the magnificent efforts now being made by Mr. Ruttledge and his gallant party to place the human foot upon the summit of the Earth. That is indeed a geographical matter in all its aspects. They have been beaten back twice, and a third attempt is now in progress. Whether successful or unsuccessful the skill and leadership displayed by Mr. Ruttledge, the endurance and loyalty of his companions, both British and native, is beyond praise. It would appear that the mountaineering difficulties are greater than had been expected. Furthermore the monsoon has been early, causing a fall of fresh snow, and the winds have been abnormally high. We still hope that we shall hear that they have reached the top, but any party which has shown such devotion has already achieved a great measure of success.

Death has deprived the Society of no less than 131 of its Fellows, and in your name I offer the sympathy of the Society to all their relations. There are a few I would mention. Prince Kemal el Din was a Fellow of many years' standing whose visits to the Libyan Desert resulted in the compilation of maps of that region which have been of great use. General Nicola Vacchelli, an Honorary Member of our Society, who did much valuable geographical work for the Italian Army, was Director of the Military Geographical Institute and responsible for the training of the Italian representatives on the Boundary

Commissions which were the outcome of the Peace Treaties. It will be remembered that he presided over the International Geographical Congress in London and Cambridge five years ago when he was made an Honorary Doctor of Science of Cambridge University. Colonel de Lancey Forth made a remarkable camel journey in the African Desert and piloted his caravan when he found his guide was useless. Professor Brigham, an Honorary Member, was a conspicuously successful teacher of geography in the United States. Sir Everard im Thurn, an authority on the Pacific Islands, was a former Member of Council. The death of Gino Watkins—for it is by that name that all knew him—is one of those losses to which it is not easy to refer. That at twenty-five a man should attain a European, almost a world-wide, reputation, without any apparent effort on his own part, is one of those things which is beyond explanation. When he was in England I saw him almost daily, and as I and others have expressed, both in this Hall and in the public Press, it is difficult to determine which was the greatest—his loss or the encouragement which his life gave to all who would live absolutely unselfishly for the advancement of what he believed in.

I have left to the last mention of one who devoted his life to geographical knowledge in its widest sense—His late Royal Highness the Duke of the Abruzzi. It was a great privilege to us to be able to hold in this Hall a meeting which took the form of a memorial to him. To have such a distinguished compatriot of his as Professor Dainelli to speak of him and three men—Lord Conway, Sir Halford McKinder, and Mr. Wordie—who followed the Professor and spoke of the Duke of the Abruzzi's work, will remain as our monument to him. In the end, it came to this, what I have already referred to, his devotion to the amelioration of the conditions of the human race. I need hardly say I refer to the last few years which he spent in Somaliland.

Financial matters are those which have to do with the more domestic part of this meeting, when only Fellows are present. There are however some remarks I would make more publicly. We are free from debt, and in this connection I would again offer the thanks, not only of the Society but of all who have our activities at heart, to that Committee of Lord Goschen, Sir Harcourt Butler, Sir Mathew Nathan, and Mr. Francis Rodd, who gave their invaluable support and advice to the Hon. Treasurer and myself in the circumstances which have caused that happy event.

Our prestige in geographical matters, both in this country and abroad, stands as high as ever. One thing is needed, and that is an extended Fellowship. I invite, without any apology, all those who believe in the importance of the Society to join us. We do not expect that every Fellow should be a great traveller or have special knowledge, but a desire to advance our activities is what is necessary. From a material point of view I would say that for the subscription the advantages, we believe, are very great. Use of the Library, the supply of the *Journal*, the boundless interests which our Museum and other things in this building provide, the afternoon and evening lectures and the cinematograph films, would seem well worth the subscription of £3 a year.

Once again I have to speak of our gratitude to the staff. Their work increases year by year, and it was a great pleasure to hear on more than one occasion people speaking of their courtesy and attention.

I have left to the last to speak of one loss we are to sustain. At the end of this month we are to lose the services of Mr. Edward Reeves. It would need a volume to describe what Mr. Reeves's work for the Society has been. He has served the Society for fifty-five years. He joined the staff in 1878 in a subordinate position. By his character, natural talents, perseverance, determination, and application to his work, he holds at this moment a world-wide reputation in all branches of surveying. Listen for a moment to this record. He was appointed Map Curator in 1900, Instructor in surveying in 1902, became responsible for the draughtsmen in 1904. He has taught pupils in this building approaching some two thousand in number, and of these no less than twenty-one have received Gold Medals and many others minor awards. Over and over again have we been told by some of the greatest travellers of the age that they look back on their instruction from Mr. Reeves as one of the greatest assets that they possess. It takes one back some way to know that one of his first tasks was to copy out a list of instruments to be taken by Joseph Thompson on his journey from Mombasa to Victoria Nyanza. He edited the Ninth Edition of 'Hints to Travellers' in 1906, the Tenth Edition in 1921, and the edition which is now in the Press. He was President of the Geographical section of the British Association in 1916. At the proper moment a full recognition of his services will be made in the *Journal*. All I can do now is to record an expression of admiration and gratitude which has no limit.

Mr. Reeves's place as Map Curator will be taken by Mr. Allen, and Mr. Gilmore, who has joined the Society's staff, will undertake the instruction and have charge of the draughtsmen's office.

The report of the Council is with you and I hope that all will study it. You will there see many things. That instruments to the approximate value of £1350 have been lent to various people; that Grants to the amount of £950 have been made to expeditions, and what we deem of great importance is that the new edition of 'Hints to Travellers,' as well as other publications, will shortly be ready for sale at what would appear to be a very cheap price. I may add that we are able to set to one side the sum of £1000, which will be given to what is termed a Special Publications Grant, and that will include the starting of the index to the Library, the publication of the Karakoram Map, in addition to 'Hints to Travellers.'

This is the third and necessarily the last occasion on which I shall address you as President. I beg to be allowed to take the opportunity of thanking all connected with the Society, Council, Fellows, and Staff, for the assistance they have been to me in carrying out a very delightful and honourable task.

A FURTHER JOURNEY THROUGH THE LIBYAN DESERT:

A paper read at the Evening Meeting of the Society on 29 May 1933 by Mr. W. B. K. Shaw on behalf of

MAJOR R. A. BAGNOLD, Royal Signals

SOME confusion of ideas seems to exist as to the extent and boundaries of the Libyan Desert, and as to its distinction from the Sahara. In the absence of any official definition, it is useful to consider the dividing line in the west as the belt of high ground Fezzan—Tibesti—Ennedi, and to limit the term Sahara to the French territory in the west. According to this description, then, the Libyan Desert covers one huge unbroken tract of true desert stretching from the foot of the high ground in the west to the River Nile in the east, a distance varying from 1100 miles in the north to 600 miles in the south. The southern boundary may be taken as the northern limit of annual summer rainfall, about lat. 18° N., so that the desert extends for about 1000 miles from north to south.

The whole area is almost uniform in character. With the notable exception of 'Uweinat there are no mountains worthy of the name, the surface consisting of gently tilted flats of bare rock, gravel, or sand, with low hills, falling steeply to lower levels by scarps sometimes over 1000 feet in height. Rain falls too seldom in any one place to support permanent vegetation other than an occasional plant of the specialized drought-proof variety. Scattered at intervals of several hundred miles lie the oasis-depressions, usually surrounded by cliffs, and deep enough to penetrate to the level of the artesian water which is the only permanent source of supply in the country. Over parts of the intervening desert great systems of sand-dunes have developed, and these, together with the long uninterrupted escarpments, form the principal obstacles to exploration; for, with modern cars, the lack of water is no longer a serious difficulty.

Prior to 1920 the Libyan Desert was the largest unexplored area in the world, but now, thanks to Hassanein Bey, the late Prince Kemal el Din, and others, the country has been covered by a network of travellers' routes. But many problems of this country are hard to solve, chiefly owing to the total lack of long-period observation in an uninhabited area; and each journey across the desert adds but a little to our knowledge of such questions as the frequency of rainfall both past and present, the origin and amount of the available artesian water, the cause, life history and organization of the great sand-dune systems, the ages and characters of the past human occupations of the country, etc.

On two previous journeys, in 1929 and 1930, which I described before this Society two years ago, we were able to obtain some knowledge of the sand-dune country between Siwa and 'Uweinat, and of the open desert between 'Uweinat and Wadi Halfa. With the Italian occupation and pacification of the interior of their province of Libya, there remained three large areas about which very little was known. First, the country between our 1930 route in the Sand Sea and Kufra Oasis; second, the Sarra Triangle or the tongue of Sudanese territory which juts out westwards to the Tibesti Mountains; and third, the country south of 'Uweinat between the French frontier and the line Malha—El Atrun (or Bir Natrun)—Merga. It seemed to us that by visiting the two latter areas.

we should be putting our perhaps unique experience of very long-distance light-car expeditions to the best use, and at the same time we should gain a wider view of the Libyan Desert as a whole than has hitherto been possible. Mr. P. A. Clayton, of the Egyptian Desert Surveys, has been attacking the northern Sand Sea area this winter.

Four Ford car chassis were bought in Cairo and fitted out by Lieut. G. L. Prendergast and Lieut. R. N. Harding-Newman, of the Royal Tank Corps, on the same lines as for the 1930 expedition. The other members of our party were Mr. W. B. K. Shaw; Dr. K. S. Sandford; Major J. E. H. Boustead, of the Sudan Camel Corps; Captain V. F. Craig, Royal Engineers; Lieut. D. R. Paterson, Royal Corps of Signals; and myself. All the transport arrangements, including the maintenance of the cars during the expedition, were undertaken by Prendergast, Harding-Newman, and myself. Craig took on the food supplies and navigation, Paterson looked after the chronometers and took the wireless time signals nightly; he and Shaw made the daily astronomical observations; the latter was also responsible for botany and for the aneroid readings. Sandford dealt with geology and, with Shaw, with archaeology, and to Boustead and Prendergast are due our collection of birds, insects, etc.

We are indebted to Dr. James Breasted, the Director of the Oriental Institute of the University of Chicago, for a generous contribution to our expenses. The Royal Geographical Society gave us a similar sum—for half of which we have to thank Mrs. Patrick Ness—and lent us many instruments. The greater part of the cost however was shared among the members of the party. Our thanks are also due to the Director and officers of the Desert Surveys of Egypt and to the officials of the Sudan Political Service for the help which they so generously afforded us.

Our plan was to form, with our own cars, a large dump of petrol and food at 'Uweinat sufficient for (1) a 1200-mile journey westward into the Sarra Triangle; and (2) a journey of a possible 1400 miles from 'Uweinat south to El Fasher, the nearest point in that direction where further supplies could be got. For the dump at 'Uweinat it was arranged that the Shell Co. should send, with the assistance of the Governor of Halfa, a supply of 1000 gallons of petrol and oil to Selima Oasis which we would pick up and transport to 'Uweinat. This would entail on our part two complete double journeys of 600 miles each between 'Uweinat and Selima, but it was the most economical method by which we could get the supplies to 'Uweinat.

1. CAIRO—'UWEINAT—SELIMA

We left Cairo on 27 September 1932 with all the food and spare parts wanted for the whole journey. The cars had been stripped of every unnecessary part to save weight, and so the absence of mudguards made us avoid the mud road up the Nile valley to Asyut, whence the direct track to Kharga runs across the desert. Instead, we turned into the desert just south of the Faiyum, and ran south-west to meet the Abu Moharik dune belt along the side of which we proposed to run till near the Kharga cliffs, when we would strike south-east to the head of the Yabsa Pass. The going, on gravel and hard sand, was so good that we kept to the dune edge too long before turning eastward, with the result

that we became entrapped in a series of parallel wind-scored corridors in the rock, which led straight for the brink of the precipitous cliffs of the depression. The traverse eastward along the top of the cliffs to reach the Yabsa Pass covered the rockiest and worst country I have ever taken a car over. At times it seemed incredible that the chassis could hold together any longer. Fortunately we got through with nothing worse than burst tyres, and Wing-Commander Penderel, who happened just at that time to be flying out to Kharga and beyond, preparing dumps of petrol for a flight to 'Uweinat, was good enough to bring us out a supply of new tyres to replace the damaged ones.

From Kharga our proposed route lay almost in a direct line for 'Uweinat across the unknown country between the tracks of Mr. Harding King and those of Prince Kemal el Din. The going was on the whole good, though as far as Camp 7 the firm sand surface is spoilt in places by areas of waves sometimes 8 feet from crest to crest, which necessitate long spells of very low-gear work to spare the cars from excessive strain. As far as Camp 7, too, we passed a succession of shallow depressions containing pillars of mud as evidence of former mud-pans. Round the borders of these depressions Sandford and Shaw found stone implements of neolithic type and many querns and grinding-stones.

Shortly after Camp 7 we entered very broken country. The ground rose to over 2000 feet and the rocky hills about us were at least another 400 feet higher. We found ourselves in a valley at the bottom of which ran a dry water-course which we descended for more than 4 miles. The wadi showed obvious signs of having run with water within fairly recent years. After passing through a small gorge, where we had to do some road making, the wadi opened out into a wide empty basin disappointingly devoid of all signs of life. These sudden evidences of heavy rainfall are very astonishing, surrounded as they are by the almost limitless wind-eroded sandstone wastes without a single sign of any waterflow. It is curious that such a small change in elevation should make such a difference in the character of the country. Even the Gilf Kebir, 50 miles away to the west, is but 1000 feet above the surrounding plains, and yet great wadis have carried debris far out into the plains.

We then came on to a great sand-sheet which continued with few interruptions to within sight of 'Uweinat and Kissu mountains. There are many such sand-sheets, of varying size, by far the greatest so far discovered in this desert being that lying west and north of Selima. They appear to be a distinct sand phenomenon and can be recognized at once from other types of flat desert. The sand, instead of tending to accumulate to form dune colonies, seems to possess here some inherent tendency to flatness, as if oil had been poured over an ocean. Every feature disappears. The horizon becomes a hard straight line in every direction. Very occasionally one glides past a small group of pebbles, the last vestiges of a rock outcrop not yet utterly destroyed by erosion or submerged by the sand.

We steered straight for Gebel Kissu, where we had decided to make our dump. On the 1930 expedition we had left a broken-down car near 'Uweinat itself and a small dump of petrol and food. A few months later Mr. P. A. Clayton found them. The car had been shot at and damaged. This time we did not know if 'Uweinat was occupied or not, and thought it safer to leave our

precious petrol 20 miles away at waterless Kissu. However we found on arrival on October 5 that even our old camping site at Kissu had been picked over. Nothing remained of our rubbish except a short piece of string and a sardine tin. Notwithstanding, we dumped here all our food, water, spares, etc., and the remainder of our petrol, and drove across the intervening plain to 'Ain Duwa at the west end of 'Uweinat mountain. There were no signs of occupation. A broken wood crate proved no native had been here since an Italian patrol had left it behind. There was plenty of water in the pool.

Craig, Sandford, Shaw, and Prendergast remained at 'Uweinat with one car to visit the volcanic craters between 'Uweinat and the Gilf Kebir, which the Almásy-Clayton expedition had reported having seen from the air. The rest of the party with the other three empty cars left at once for Selima, 300 miles away to the east, for the first of the two 500-gallon loads of petrol and oil. We followed Mr. Beadnell's route for portions of the first 120 miles, but, avoiding his Bir Messaha, which was out of the direct route, struck through the big belt of *barchan* dunes just east of long. 27°, some miles farther south. This belt appears to be more than 100 miles long, for in 1930 we crossed a continuation of it far to the south. It is 7 or 8 miles wide, and consists of big *barchans* very close together but yet isolated from one another by narrow winding strips of the flat desert floor. The belt can probably be crossed anywhere south of lat. 22°.

The great Selima sand-sheet began before we reached this dune belt and continued without a break for 130 miles, to within 50 miles of Selima itself. It extends northwards as far as Bir Terfawi and southwards to somewhere about lat. 21°. Its area must be not less than 20,000 square miles. Motoring on it is terribly monotonous, and it is hard to keep awake. It could be crossed at 50 miles an hour. It is curious that the cars would go faster and use less petrol while crossing this area when they were heavily loaded with a cargo of 160 gallons of petrol each than when running empty. On each of the four journeys we made between Kissu and Selima a slightly better route was found across the other, rocky, portion of the desert. Finally the 300-mile journey was accomplished with fully loaded cars in one day of less than eleven hours.

Selima as a base for supplies for 'Uweinat and beyond is strongly recommended to any one who may be thinking of future expeditions.

During the four days they were alone at 'Uweinat the remainder of the party visited and fixed the position of the craters which Sandford was able to investigate geologically. Afterwards they made a tour of the 'Uweinat valleys at Karkur Murr, Karkur Talh, Karkur Ibrahim, and 'Ain Zuweia to collect botanical specimens and to verify that no traces remained of Herri and his little band of friendly Guraan who were still living in the mountain when we visited it in 1930. The whole mountain was very dry. All the vegetation was more withered than in 1930, and it seems that no rain has fallen since the floods of 1927, which Prince Kemal el Din reported as having covered the surrounding desert near 'Ain Duwa to a depth of 5 feet or more.

On October 8 and 9 an Italian military patrol arrived at 'Ain Duwa from Kufara in lorries, with Major Rolle, Governor of Kufara, in command. Lieut. San Severino, of the Royal Italian Air Force, accompanied him. They were followed by Colonel Lodi, chief of the Air Force in Libya, with two military

aeroplanes. Shortly afterwards Penderel also arrived in a big Victoria troop carrier, landed at Kissu, and camped with us.

Craig, Sandford, Prendergast, and Harding-Newman left for Selima on October 10. The others—Shaw, Boustead, Paterson, and I—after paying a visit to the Italians at 'Ain Duwa, set out for the summit of 'Uweinat. It was an arduous and very thirsty scramble. For the benefit of any survey party which may in future have to repeat the performance, our advice is to begin by approaching the foot of the Triple Peak by car from the direction of Karkur Murr, keeping close to the mountain. A good sandy wadi runs right up to the foot of the first 1000-foot rise. From the more obvious direction of Ras Rejm, due south of the Triple Peak, false ridges cut one off from the mountain itself. An easy way up the main cliffs can be found to the west of the Triple Peak up the neck joining it to the western of the two sandstone massifs. A series of deep narrow clefts through the maze of vertical pinnacles of eroded rock brings one out on to the slopes of the main dome, whence it is an easy walk to the top. A very liberal quantity of water should be taken.

On October 12 the second Selima party returned, and the following day we repacked and moved over to 'Ain Duwa, leaving 300 gallons of petrol and some food behind at Kissu for the journey south to El Fasher. After taking 100 gallons of water from the pool, the level was nearly 12 inches lower than when we first arrived. The area of water surface visible between the great granite boulders around the pool was now very small. The Italian party of thirty men must also have drawn on it considerably, but though they were still there ten days later on our return from the west, the level of the water had actually risen to within 3 inches of its original height. It seems therefore that there is little danger of future parties finding the pool dry.

2. THE SARRA TRIANGLE

We left for Sarra Well, 200 miles away, on the evening of October 13, following Prince Kemal el Din's tracks which led for the first 15 miles over an open plain of pebbles varying from 2 to 6 inches in size, resting on dried mud which here and there contained hollows with dead grass. The Prince's tracks had in some places sunk deep in this mud, and he had reported the hollows full of water. Well-worn gazelle tracks crossing the country in every direction prove that there is periodical grazing here, though the pebble surface now appears as dry and barren as any desert.

The Prince's map of this area shows a sudden change in the direction of the straight parallel lines of *seif* dunes which cross the country from north-east to south-west (Arabic *seif*—a sword). We turned northwards to verify the bearing of that portion of the dune field to the north-west of the Prince's bend. It is a fact that the southern edge of the dune field does actually change direction as he showed, the edge consisting of a continuous whaleback ridge of sand which hides the dunes inside from sight. But the dunes themselves are not parallel to it. They run more east and west on a bearing of 240°, almost parallel to the dunes which the Prince actually penetrated farther on beyond his supposed bend, and whose bearing he showed correctly.

We found here, on the south-east edge of the sand, a shallow depression containing a mud pan on which a large clump of several acres of trees and scrub

is still growing. The place was full of gazelle, two of which made a welcome change from our usual tinned food.

The dune field which we crossed gradually, slantwise, working westward as opportunity offered, consists of long lines of *seif* dunes very much like those in the southern part of the Sand Sea. The dunes lie directly on the desert floor or on a floor of continuous billowy sand. There are no whalebacks. The sand billows provide excellent going if one's tyres are suitably deflated. We took the Prince's more southerly route to avoid the second dune field which gave him much trouble in crossing, and on the 15th struck the Tekro–Sarra camel road about 15 miles south of Sarra. Fresh tracks of a caravan of camels and goats led us easily to the well, over an otherwise featureless sand-sheet. There is no vegetation at Sarra and no conspicuous feature nearer than the wall of the Sanya Dunes some miles to the west. The well might be difficult to find until the group of tiny '*alems* immediately surrounding it were picked up. Though Bruneau de Laborie, Prince Kemal el Din, and several Italians have been to Sarra, we appear to be the first British party to visit the well, although it has been shown as lying in Sudanese territory for many years.

The well itself is a rock-cut shaft some 6 feet in diameter and descends 195 feet to the water-level. The water is good, but very slightly sulphurous. The same rope and pulley were there that both de Laborie and the Prince had used. They were formerly maintained by the Senussi from Kufara. We found another Italian patrol from Kufara, under Major Lorenzini, camped at the well, and spent a very pleasant evening in his company. We saw with interest Hassanein's camera which he left at Kufara with the Senussi, and which Lorenzini, who was one of the first Italians to enter the place in 1931, found abandoned in a house. Before leaving the subject of Sarra I should like to pay tribute to the friendliness and generous assistance shown us both at 'Uweinat and Sarra by these Italian officers who placed everything they had at our disposal.

The great dune belt, called near here the Seif es Sanya, appears to stretch continuously along the west side of the Kufara—Sarra—Tekro caravan road from Bishara Well to far south of Sarra. Bruneau de Laborie shows it reaching almost to Tekro. It has never been crossed before. As with nearly all the big belts of *seif* dunes, the direction of the edge of the belt (which here follows that of the caravan road running about 200°) is no indication of the direction of the dune ranges themselves. These, we found, run at 240° and are arranged *en échelon*, so that, going south, one meets a succession of beginnings of fresh ranges. From a distance the dune barrier appears continuous and formidable. We entered it a few miles south-west of Sarra slantwise through a gap where one range overlaps the next, and were able to cross them almost due west by zigzagging up and down over cols in each successive range where there were no steep slopes of streaming sand. The belt is about 12 miles wide, but after some troublous hours spent in gaining experience of the general layout of firm and soft sand, we managed the last part of the crossing without difficulty.

For some time we followed a vague line of '*alems* westward. The ground rises gradually, and the surface becomes very rough, being composed of black jagged blocks of hard silicified sandstone. About long. 21° 20′, some miles east of Camp 20, the height reaches 2000 feet and the ground is dissected by

drainage runnels falling to deep narrow ravines. At Camp 20 we were on the highest part of a very boulder-strewn plateau over 2200 feet above sea-level, falling gradually towards Sarra in the east and abruptly to the west by a big indented escarpment 200 or 300 feet high. The ravines we had found probably drain round into the gulfs which run eastwards for long distances into the plateau. To the westward a sandy depression stretched away from the foot of the cliffs as far as we could see, and appeared to be a broad valley draining towards the north. The cliffs we were on ran to the north and south in a series of big headlands apparently rising in height to the northward.

We descended the scarp with some difficulty, being delayed by the exhaust pipe of my car getting carried away by a rock. Continuing westward across the sandy plain below, we were finally stopped by a new and very formidable sand-dune barrier of the type which occurs whenever a *seif* belt is checked in its progress by rising ground. Range after range is piled one on top of the other, forming a huge confused ridge of great height. We might have crossed it with much difficulty, but shirked the probability of having to recross both these dunes and the Seif es Sanya farther south, where they might both be more difficult still. So we followed the near edge of the dunes to the south-west. As before, the dune-edge ran much nearer south than the dunes themselves, which still kept to the general bearing of 240°. The cliffs on the east continued. The ground rose steadily till we reached 2340 feet but fell again to 2050 feet at Camp 21. Here we could see nothing in any direction except to the west, where the great peaks of Tibesti rose above the horizon. The dune belt on our right had ended, the sand-flow spreading out into a choppy sea of circular sand mounds 100 yards or so in diameter over which we ran without any trouble. Some were true *barchan* dunes, but most were plain mounds without the typical concave hollows in the leeward side. A quantity of grass had recently grown up and died in the sand, and in places there were quite thick tussocks, suggesting that some at least of the grass remained alive between the rare showers, continuing to grow in size when revived by rain.

Next day, October 18, we pushed on south-west for a further 25 miles, off the sand and on to rocky rising country which became so difficult that we decided to turn south-east and make for Tekro. The country here is scored into grooves 10 to 50 feet deep, each running in the south-west direction of the prevailing wind. Their bottoms are filled with sand drifts which, though very firm, are impossible to drive along owing to their surface being wrinkled up into corrugations several feet from crest to crest. The grooves and the corrugated sand in them resemble the hollow of the roof of a dog's mouth. We could not drive along the teeth of the rocks nor along the sand in between.

At this point, lat. 21°, long. 20°, we appeared to be on the top of an important ridge. Probably it agrees with the high ground marked vaguely on the French map. The height is about 2280 feet and the ground seems to fall to the west and south-west into the curious trough which runs along the foot of the Tibesti mountains absorbing all the eastern drainage.

To the south-east we soon found better going, being guided by Sandford's advice as to the most likely direction geologically in which to find the best and smoothest strata of the sandstone. Our course ran gently downhill for 120 miles to Tekro, which appears to lie in the trough just referred to. Before reaching

Tekro we should have recrossed the line of the Sanya dunes, but we saw nothing of them except once, when we crossed an area of sand mounds and undulations which may indicate the extreme end of the dune belt.

Tekro consists of a strip of sand-drifted scrub, mostly *Salvadora persica*, about 2 miles in length under a little scarp less than 100 feet high. There are no permanent inhabitants, but the French keep there a couple of natives from the nearest village of Unianga, who are relieved periodically, and whose job is to "look after the oasis." From the many tracks it seems that the road to Sarra and Kufara is still often used by caravans. Trade consists chiefly of small cattle going northwards to supply Kufara with meat, in return for European produce going southwards. The water in the small stone-lined well is within 3 feet of the surface. It is strongly sulphurous. From the cliff above the oasis it is possible to see a long way to the south and south-west. The country is flat and almost entirely covered with sand, which should provide good going for cars with suitable tyres.

We left Tekro north-east for 'Uweinat on the morning of October 20. After a few miles of ordinary desert with some rocks we came on to a wide smooth plain of sand which continued till, 40 miles from Tekro, we met a long cliff which must form the southern edge of the Jef-Jef Plateau indicated roughly on the maps. We ran east-north-east on very good going along the foot of these cliffs, which are about 100 to 200 feet in height. A few trees, mostly *tundub*, are growing in the sand here, and we saw some fresh gazelle tracks. Farther on, about halfway between Tekro and Camp 24, nestling under the cliffs of a bay in the plateau, which here corresponds perhaps with the Gebel Hadid of the Sudan map, was a mud hollow containing green trees in two big clumps, the whole covering some 50 acres. At first sight, an oasis! But it was soon quite clear that the area had been flooded some years ago by water from a heavy local storm but is now very dry indeed. Only one kind of tree, acacia, and only one kind of scrub still lives. Everything else is dead. The ground is nearly white with the little shells of one particular kind of freshwater shell-fish which must have multiplied in millions during the period when the area must have been a lake. The present desiccation cannot have lasted for very long, as the large numbers of empty lizard holes have not yet crumbled in. We found no trace of human visitation, no camel bones, nor any fresh tracks even of gazelle. But the place was full of big flies, which finally drove us away by their unwelcome interest.

At this point the cliffs of another plateau appeared to the east, and we ran between cliffs along a sort of corridor down which a veritable river of sand had flowed in huge billows. We drove over them for many miles as over a vast switchback. Forty miles on, the corridor narrows and then opens out, the cliffs falling away rapidly to the flanks. We here entered a sand sea of parallel *seif* dune lines, and met no more solid ground for over 50 miles. These dunes are evidently the south-western continuation of Prince Kemal el Din's dune field west of 'Uweinat, here very much denser and more spread out. We had no difficulty with them, as the lanes of billows between the dune lines ran almost in our direction. All we had to do was to work leisurely eastward across the lines whenever a chance came.

This area is full of ancient sites, whose age and type I will leave Shaw to

discuss. Almost every hollow in the dunes contains an untidy collection of shapeless broken stones, stone implements, and grinders. They lie in sand hollows, but not on hard solid ground, and always very near the dunes themselves. It is a very definite fact, both here and wherever we found these "dune sites," that the sand under the sites is far softer than elsewhere. Directly one leaves the scattered stones of the site the sand becomes firm again. On the south-east border of the sand the sites were particularly thick, in fact, one continuous site may be said to stretch all along. There were querns and grinders every 100 yards for miles together. But except for the "False oasis of J. Hadid" we saw no sign of vegetation on the whole journey between Tekro and 'Uweinat. We finally left the dunes receding away to our left, and entered a sand-sheet which reached as far as the Prince's Sandara Hill, within sight of 'Uweinat. At Sandara and in its neighbourhood Sandford found an area of volcanic craters similar to those recently found north of 'Uweinat.[1]

This round trip of 1000 miles was completed by our return to Kissu on October 22. Here all the remaining supplies were loaded up. We spent one night with the Italians at 'Ain Duwa, where we filled up with water for the long journey to El Fasher, and finally departed on the morning of October 23.

3. 'UWEINAT TO EL FASHER

West of the line 'Uweinat—Merga—El Atrun—Gebel Teiga, the desert as far as the French frontier had not previously been explored except for the Prince's triangular journey from 'Uweinat to Beacon Point and across to Merga; but a detailed survey of the French territory has been made by them. We therefore proposed to see as much of this unknown strip of desert as we could on our way south. It was not quite clear however whether the sudden fading out of all detail shown on the French maps just at the frontier was due to the presence of the frontier or to the fact that no detail existed, so we determined to touch the frontier at intervals on the way south.

We ran due south from 'Ain Duwa over flat and featureless sand, heading for Yerguehda Hill, mapped but not visited by Dr. Ball on the Prince's expedition of 1925. A strong east wind blew most of the day, driving a low cloud of sand over the surfaces of all the sand dunes we crossed, but there was no sand movement on the flat areas of sand-sheet. A small incident may emphasize the amazing flatness of these sheets. We halted for lunch and filled up the tank of one of the cars with petrol. Two square 4-gallon tins were emptied and thrown away. The wind caught them and tumbled them over on their successive sides. We watched them flopping slowly and steadily over and over along the sand almost side by side till with glasses we saw them disappear over the horizon.

Yerguehda Hill is the most conspicuous landmark in this country south of 'Uweinat. It stands quite alone, many miles south of the last hills of the 'Uweinat–Kissu group. Owing to a draughtsman's error it has been placed on published maps several miles west of its true position as fixed by Dr. Ball. Here stone implements were found and circular stone platforms at the base of the hill, and rock paintings on the northern cliff (see Section 8).

[1] These craters, and those to the north of 'Uweinat, have been described by Sandford in *Nature* of 14 January 1933, p. 46.

Just south of this hill a belt of low *seif* dunes runs across the plain from north-east to south-west. These were the last *seif* dunes seen by us in the Sudan, and except for some very small *barchans* in the Mourdi Depression, the last dunes of any kind seen on the journey south to El Fasher.

We continued south to lat. 20° 30′ and then turned south-west, heading for the corner of the frontier where the French had built in 1924 a small boundary cairn. The place has come to be known as "Beacon Point." The ground begins to rise to the south-west of Yerguehda Hill, and at lat. 20° reached 2500 feet. This high ground appears to be a spur of the Erdi Plateau which runs north-east from between Erdi Well and the Mourdi Depression to Beacon Point and on up as far as lat. 20°. We drove along the foot of the north-west cliffs of this spur, descending into a trough-like depression which runs into the main Erdi Plateau at Erdi Well. At Camp 28 we were in a basin not more than 300 feet deep quite devoid of vegetation but surrounded by boulder-strewn drainage wadis from the rugged cliffs above, on which presumably stood the cairn. But the upper country looked so rough that we gave up the idea of searching for the cairn and, ascending the cliffs farther south, turned eastward parallel to the Prince's track but to the south of it. The plateau here is composed of hard black sandstone blocks, but rapidly improves to the east. Very near long. 24°, and several miles south of Beacon Point, we came, to our surprise, on the actual French cairn, well sited on a prominent mound but certainly not where it should be. Our observations of its precise latitude agree well with the relative position of the Prince's track, which we located shortly afterwards. Our corrected aneroid readings show the height here to be about 2560 feet. This cairn is 6 miles too far south.

The next objective was the eastern end of the Mourdi Depression, which we reached by a detour eastward to avoid the rocky going over the plateau along the actual frontier. The country crossed consisted mostly of flat sand with sandstone outcrops. The general altitude is 2450 feet. Whether or not a downward scarp exists to the east I cannot say. Possibly the cliffs of the Mourdi Depression curl round and run northwards somewhere farther east, but they appeared to fade away not far to the east of our descent of them.

Here I must explain a cross current in our objectives. In order to make full use of our presence in this neighbourhood we were anxious to gain any possible information as to the whereabouts of the band of Guraan raiders who, under the leadership of a certain Gongoi, had for years been giving trouble in places as far apart as the Nile near Dongola, Sendia, north-west of El Fasher, villages in French Equatoria, and El Atrun Oasis. Rumour had it that two of their favourite haunts were the Mourdi Depression and the mouth of the Wadi Guroguro.

We had heard from the natives at Tekro that the band was last heard of in the Mourdi Depression, and so proceeded with caution. At Camp 29 an armed guard was maintained all night, and we moved off before dawn next morning, October 26. Descending the cliffs, which are here about 250 feet high, we turned west and ran down towards the French frontier. The deepest part of the valley is along the northern side beneath the cliffs. The ground here is composed of dark fertile-looking powdery mud strewn with pebbles. It was very soft, and we soon shifted across the valley to the gentle southern slopes of

smooth sand. With suitably soft tyres this sand proved excellent going. For the first time since leaving the Nile a month before, after a journey of more than 3000 miles, we saw fresh green rain-given vegetation. It was growing in the loose sand, very low and thin, but evidently quite fresh. The earth a short distance across the valley however was quite devoid of any sign of life. Some miles west of the frontier the sand became covered with large hummocks of grass, dead above ground, but presumably just alive somewhere and able to revive and grow after each rain. Game tracks abounded in the sand. We saw gazelle and one addax antelope, whose presence practically precluded the possibility of there being humans in the valley. From our most westward point we could look along the whole line of the Erdi cliffs, here very high and sheer.

We camped that night in the depression, and next morning, October 27, set out to the south-east on a reconnaissance of the unknown desert as far as long. 25°. The wide sandy southern border of the depression rose some 400 feet to a ridge of rock and drifted sand. We then descended till the rocky desert suddenly gave place to a flat sand-sheet which in turn soon changed to a vast sea of gently undulating sand billows with no visible bottom. We drove over this at a general altitude of 2050 feet for 60 miles, seeing nothing but sand. At long. 25° we halted and turned south-west, making for Wadi Guroguro. These sand billows evidently extend eastwards without interruption to near long. 26°, for we traversed the same type of country on our return journey northwards. Just south of lat. 18°, when signs of living vegetation had hardly begun to appear, was a small forest, 5 miles wide, of dead trees whose trunks, 10 to 12 inches in diameter, cut off at ground-level by the sand blast, lay strewn about over the sand.

Lat. 18° marks the end of the true "howling" desert of the north, at any rate as far as this pure sand country between long. 24° and 26° is concerned. South of lat. 18° the sand is covered either with a thin film of green shoots from this year's rain or with little dead or half-dead tufts from the rain of previous years. The first animals to be met with going south are gazelle and addax. On approaching long. 24° from the east the billowy sand ceases, giving place to low rock outcrops and small hills. The country was very green wherever the sand accumulations persisted. The land rises to the west very gradually with shallow indefinite little valley systems containing groups of fantastic pillars of sandstone like ruined towns. We found many rock pictures on the shady northern faces of these pillars. Again there was no sign whatever of present-day humans or of camels. Fresh game tracks abounded and also those of ostrich. Foxes sat up watching us over the edges of their little sandy lairs. Birds were plentiful. The vegetation increases very rapidly as soon as the land begins to rise. The country is green with acacia and other trees, grasses and scrub. The highest aneroid height which we reached with the cars was 2590 feet. There is excellent grazing in this Guroguro country, but we were unable to find the reported well of the Guraan, and unfortunately missed the other reported well, Haramba, owing to our being given a wrong latitude for it. It would be difficult for cars to penetrate much farther west on account of the size of the sand hummocks and the large areas of flat rock slabs separated by wide cracks.

On October 29 we set out on another detour to the east, this time to strike the Wadi Hawa and work back along it to the south-west before a final southward run to Kutum and El Fasher. The rolling sand began again in great waves averaging 200 yards from crest to crest. The sand was green with fresh plant life. Game in large numbers were passed. First nothing but addax and gazelle, then oryx in herds of twenty to fifty also accompanied by gazelle. The addax faded out at lat. 16° 45′, but the oryx continued far to the south. We first met ostrich at lat. 16° 30′, and soon afterwards found them in herds of forty to eighty. Except for the timid addax nothing seemed to be much afraid of us. The gazelle often did not bother to rise to their feet as we passed. In all this country there is no sign of recent human occupation, but obvious camel *baraking* places and old dung show that in some years at any rate the nomads have been as far north as this for the *gizu* grazing.

There was nothing to be seen except the rolling grass-covered sand downs until, 17 miles before reaching Camp 33, we came suddenly on to an apparently isolated area several miles in length of green spreading trees growing in a big mud pan surrounded by the sand. The altitude according to our aneroids is here 2300 feet—higher than the country either north or south.

Under one of the trees we found a nest of ninety-four ostrich eggs arranged in a circle about 12 feet across, and a central clutch of some twenty eggs upon which a bird was sitting. This was the only big nest we saw, but its size cannot be exceptional, for we saw later a pair of birds with a brood of more than fifty young chicks all about the same age. This rather disproves the statement in the *Encyclopaedia Britannica* that the outer ring of eggs are laid merely to provide food for the central hatching, for the latter could hardly contain as many as fifty eggs. But if the whole nest hatches out, as it appears to, it is rather difficult to see how the chicks can be of so uniform an age. In many other spots about the Wadi Hawa we saw little deserted groups of six to ten eggs, and in one such group the eggs were being broken open while we watched by a flock of vultures.

At Camp 33 the north bank of the Wadi Hawa was reached. The *wadi* consists of a thick belt of trees a mile or two wide, growing down the centre of a mud floor whose width averages about 4 miles. The banks are only just perceptible. The wadi emerges from the hills in the south-west and winds across the open rolling sand desert for more than 300 miles, rather as a flat sandless gap in the sand billows than a wadi. Except for the belt of trees one might easily drive across it without noticing anything particular. It falls in altitude from 2365 feet at long. 24° to 2085 feet at Camp 33, 1880 feet at Camp 46, and 1750 feet south of El Atrun Oasis, where it loses itself in the sands. We took several other aneroid readings along the wadi, and all the figures combine well to give a very steady fall.

West of Camp 33 there are areas in the mud floor which show signs of recent flooding. Wherever this has occurred all the vegetation, including the trees, has died. We saw nowhere however the smallest sign that any water has flowed along the wadi. West of Camp 34 there is undergrowth and grass. To the east, at Camp 46, where the rolling sand desert is far more barren both north and south of the wadi, the park-like quality of the green spreading trees and the neat white sandy floor give it a weird unreal appearance in contrast to

its surroundings. The question arises, whence do the trees derive their water? If, as seems obvious at first sight, there is an underground flow, at what depth is it? And could wells be usefully sunk? But the presence of the isolated area of the same trees to the north, growing on a mud floor exactly similar in appearance to the Wadi Hawa but as much as 300 feet higher in level, suggests another answer. If the river which once undoubtedly must have flowed in the wadi had deposited a considerable depth of suitable mud along its bed, the mud may retain enough water from local showers to keep the trees permanently alive. If this solution is correct, little or no flow of underground water down the wadi need take place. Another interesting problem about the Wadi Hawa is why, when the sand lies in huge accumulations for miles on either side of it, the actual bed is flat and devoid of sand drifts except in the extreme east, where it disappears.

Turning southward away from the Wadi Hawa not far from Sendia, we soon left the easy sand for a very difficult country of rocky hills separated by valleys of dried mud scored by the recent rains into vertical water runnels completely hidden by tall grass. The comfortable desert was at an end. From here to Kutum, life in the form of insects, thorns, and *heskanit* burrs made things decidedly unpleasant. There was still no water and no trace of human beings except for a vague camel track. The first man we saw had the blue head-dress of the Guraan; he was crouching behind a rock.

We headed first for Musbat, but the going became so bad that we sheered off eastward to more sandy open country. Due east of Musbat there were more definite signs of humanity. We met two Zaghawa women gathering some kind of fine dusty grass seed for food. The first village passed was Gomgom, at lat. 15°, but even here is no permanent water. The village gets its supply from Fugama Wells, 22 miles farther south; so that on this meridian a space of 250 miles exists between the northern edge of the vegetation and the northernmost permanent water.

The country north of El Fasher is not at all suitable for cars, except along the made road between Kutum and El Fasher. We reached El Fasher on November 3, having travelled 950 miles since leaving 'Uweinat.

4. EL FASHER TO CAIRO

We left El Fasher on the homeward journey on November 7 after a most welcome four days' rest during which we enjoyed the generous hospitality of the English residents. Boustead had to leave us at El Fasher to return to his Camel Corps at El Obeid, but his place was taken by Lieut. A. M. Finlaison, who came up from El Obeid by aeroplane to accompany us as far as Wadi Halfa.

The country north-east of El Fasher is much flatter and more open than that to the north-west, through which we had come. It consists of *gozes*, or big undulating downs of blown sand covered with grass and bushes and intersected by water gullies sunk to the level of the rock beneath. At intervals there are groups of jagged hills. The recently made car track keeps to the winding gullies owing to the heaviness of the going up on the *goz* country. I am not certain however if with modern balloon tyres run soft, and some knowledge of sand technique, the far more direct *goz* routes will not become preferred in

time to the present difficult, tortuous, and often rocky tracks along the watercourses. The only sand which we could not negotiate easily was the coarse grit of the watercourses which one has to cross and recross continually to avoid the rocks.

The track runs through Melit, Sayyah, Madu, and Malha. Beyond Melit the going is quite good all the way to Malha. But having no mudguards, windscreens, or other adequate protection from the showers of *heskanit* burrs thrown up by the front wheels, the two-days' journey through seemingly endless miles of *heskanit* grass was something of a nightmare. We had to stop at intervals to clear the seats of the cars of burrs and to extract their bundles of tiny needles from our clothes and bodies. It is extraordinary how even the lightest touch will cause these needles to stab right through one's skin.

The main features of this country north of lat. 14° are three big groups of hills whose peaks rise to 6000 feet. The Berti and the Meidob Hills are each inhabited by a people of the same name. The Teiga Plateau farther north is uninhabited and little explored, though I understand there are legends of its having been occupied not so long ago. The crater of Malha lies on the western edge of the Meidob Hills and is distinguished from outside only by the regularity of its low circular lip of lava and debris rising less than 100 feet above the parched brown plain which here shows practically no sign of human occupation.

The sudden view down into the interior is indeed an astonishing one, especially in contrast to the barrenness outside. It is one of the chief watering-places of the isolated exclusive Meidob people, who inhabit the neighbouring hills. When we saw it, the whole of the bottom of the great pit about a quarter of a mile across was swarming with men, women, and children, and their cattle watering at the many springs. The final explosion of the crater has left the level of the pit bottom well below that of the underground water-level here, so that a circle of fresh water springs surrounds and drains into the central lake. The lake contains an oozy black liquid saturated with salts. The people wade into it up to their necks and scoop up from the bottom with their feet the black crystalline sludge which they dry and sell under the name of "gundoga" to the neighbouring Berti people and to the Arab nomads. It is regarded as a certain cure for all cattle diseases. There are tales that every generation or so some remaining volcanic action takes place, when the lake-level undergoes violent changes accompanied by rumbling noises. The people are non-Arab and very independent. They speak a language of their own and possess many ancient customs, including the matrilineal inheritance of property.

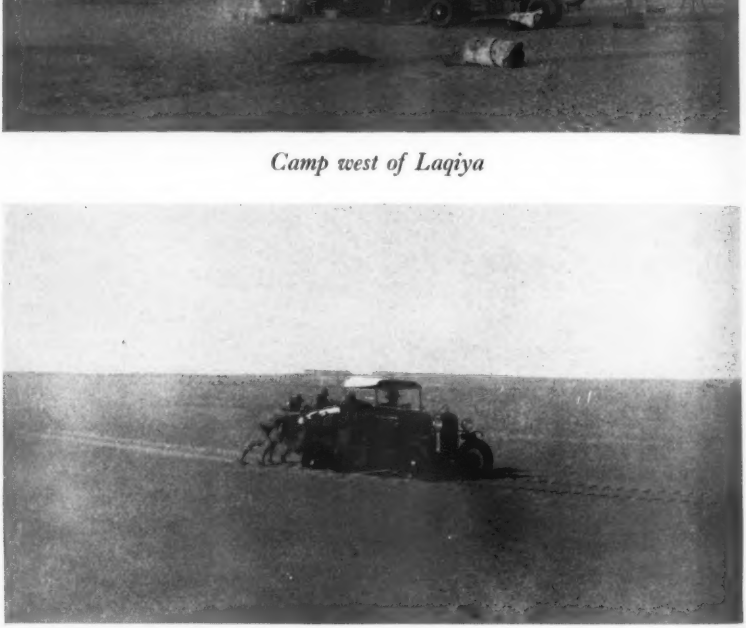
From Malha northward we still kept to the previous car tracks—those of the Motor Machine Gun Battery from El Fasher to Bir Natrun in 1931—along the banks of vertical-sided watercourses, hidden by scrub, which meander through flats of dry mud and cracked cotton soil. It was a great relief when this difficult country gave place to the open sand once more, covered though it was here by innumerable hummocks of dead grass over which it was necessary to drive very carefully in low gear.

A feature of all the sand south of the Wadi Hawa is the extent to which it is impregnated with iron. Over large areas the bare sand, deep purple in colour, is consolidated by the iron till it is as firm as dried mud. We found in one place the remains of what may have been an ancient smelting establishment.

Gebel ʿUweinat from the south

ʿAin Zuweia at Gebel ʿUweinat, showing weathering of granite rocks

Camp west of Laqiya



"Unsticking" with steel channels and rope ladders

Extricating car from soft sand

Leaving the broken country of the Teiga Plateau well to the west, we returned at last at Camp 45 to the smooth rolling sand billows we had traversed north of the Wadi Hawa on the outward journey. The grass hummocks had shrunk away gradually till nothing remained but a thin crop of light dead grass varied by wide patches of colocynth whose dead dried shells, the size of small melons, popped and crunched under our tyres. Near here Harding-Newman picked up a complete tortoise shell apparently fairly freshly shed.

From here to the Wadi Hawa the billows of red sand were almost bare. We must have crossed the track of the old Arba'in Road somewhere in this stretch of country, but the only sign of it were two camel skeletons. The Wadi Hawa itself was not encountered till 13 miles north of its estimated position as marked on the Sudan map. Many archaeological sites are scattered along the low sand slope which constitutes its northern bank.

At Camp 46 the trees of the wadi spread out and a good deal of vegetation including trees appeared in the sand to the north. Secondhand Arab reports had mentioned the existence of a "Wadi Shekaya" running north and south somewhere to the west of El Atrun Oasis, and vegetation had been seen from the air by a patrol flying westward from El Atrun. Another flight had reported seeing what appeared to be the junction of the Wadi Shekaya with the Wadi Hawa somewhere about our Camp 46. We therefore turned north with the idea of following any visible vegetation line. Clumps of *hadh* and some trees grew along what seemed to be a chain of gentle hollows. After 30 miles the line of these clumps became more ill-defined, and it appears that the "wadi" is merely a wide area containing small groups of scrub with occasional trees. In one of the larger of these we found camp-hearths, bones, and other evidences of human occupation. The old guide Bidi wad Awad mentioned once that a well was known to the Bedayat and Guraan of a generation ago somewhere in this area, but that it has since been lost.

Near lat. 18° rain had fallen during the summer of 1932, for the sand downs were green and we saw a few addax. On the whole though, the 1932 rain seems to have been confined to the west side of the sand, and game was comparatively scarce to the east. At this point, lying upside down with its bottom just protruding through the sand, we found a large earthenware jar.

We were here on the eastern edge of the billowy sand country, 60 miles west of El Atrun, and turned eastward towards the oasis. A belt of *barchan* dunes reaches down from the north-east to this point. Probably it originates in the disintegration of the sandstone of the Merga Depression which lies almost directly to windward. We crossed another such belt of dunes just north of Camp 46 which may, in the same way, have come from the hollowing out of El Atrun Oasis. The two belts seem to be the southernmost dunes in the Libyan Desert.

Our route now lay through a succession of oasis-depressions, El Atrun—Merga—the Laqiyas—and Selima. El Atrun, which we reached on November 13, was found to be unoccupied. Usually the place is visited by caravans which come to collect salt. Now, possibly through fear of the Guraan raiders (a caravan was attacked and robbed twelve months before) the wells seem to have been deserted for some time. El Atrun Oasis has been much visited by Europeans of late. The fact has come to light that the name Bir

Natrun, which has been applied in the past to the whole oasis area by cartographers, is used by the Arabs to indicate only one particular well, the most northerly one. The Arabs call the whole oasis El Atrun, and it is surely high time that the correct native name appeared on the maps.[1]

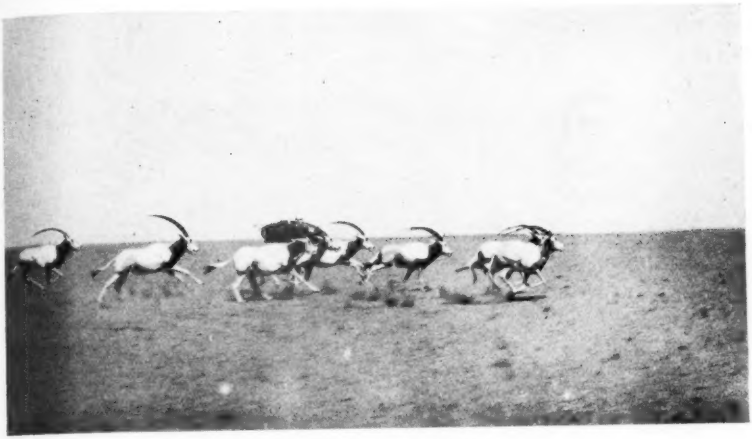
From here an afternoon's run brought us to Merga, visited and mapped for the first time by the late Prince Kemal el Din in 1925, and in the following year by Newbold and Shaw. We approached the nearest palm grove of Wa'arat el Abid with considerable caution, for here, if anywhere, the Guraan raiding party should be living. Merga has long been known to be an important raiders' camping place, especially in the summer and early autumn, when the heat and drought is too great for their animals elsewhere in the desert. Here they have unlimited water and some grazing, and can collect the autumn crop of dates of which there are considerable quantities. Merga alone of the northern Sudan oases might be able to support a small permanent population.

But Merga, like El Atrun, was empty. All we found was a group of well-built Guraan huts of grass and palm branch. Even the sacred tree to which they are supposed to sacrifice before their raids, and which Newbold and Shaw found in 1927, had been recently burnt to the ground by some unknown agency. After searching for further Guraan traces in all the palm groves of this large straggling oasis, we pushed on to the outlying depression of Wadi Hussein, first visited by Newbold and Shaw in 1927. It is a wide sandy hollow 16 miles long, full of half-dead grassy hummocks and one group of four sickly date palms: a truly dismal spot. Here also there were Guraan huts, but more ruinous and sand-invaded. There was every sign of a hasty departure a good many months previously, perhaps at the time when a single reconnoitring aeroplane had flown over the place. Scattered in the sand we found such things as Italian cartridge clips and food tins, pieces of Shell petrol tins, pieces of a British R.A.F. aeroplane which crashed at Merga in 1930, child's dolls of stuffed coloured rags on sticks, strips of cloth, date-cake and dried dates, a drum, a bag of herbs, baskets, bits of harness, leather bottles, rope, camel bones, and many very large heaps of ash indicating a prolonged period of occupation. We also saw large quantities of droppings resembling those of a cow. We collected some samples of these and afterwards showed them to badawin in Egypt, all of whom identified them as cow without hesitation. But how a large herd of cows could exist near Merga is a complete mystery. The name cow is applied by the Arabs to the antelope as well, but no addax or oryx would wander near a camping place at all events until it had been long deserted, and by that time the water-hole would have been filled in with sand.

There have been repeated rumours, reinforced by statements of the guide Bidi wad Awad, of a water-hole somewhere to the north, north-west, or north-east of Merga.[2] By the name of Bir Bidi it has even appeared on the latest edition of Philip's Atlas, but for some reason it has been placed south-west of

[1] Since the above was written I have been in communication with the Director of the Sudan Survey Department on this subject. It appears that opinions differ as to what the name of the place should be, and under the circumstances he prefers to retain the name of Bir Natrun which has been used on Sudan maps for many years. In order to avoid confusion, therefore, this name has been used on the map illustrating Major Bagnold's paper.—W. B. K. S.

[2] Vide *Geogr. J.*, vol. 72, p. 551.



Oryx near the Wadi Hawa

The Wadi Hawa

Pillars of sandstone in the Wadi Guroguro

The Wadi Kutum

Ostrich nest near the Wadi Hawa

the oasis. Recent native reports, too, mentioned a place called Oyo where the raiders were said to be lurking. The most probable answer is that Oyo and Newbold and Shaw's Wadi Hussein are one and the same place, and that Bir Bidi, if it still exists, is merely a hollow in impervious rock where water collects underground for a year or more after rain and is not a new depression reaching down to the permanent artesian water-level. There are now five traversed routes diverging from Merga in northerly directions. Along each one the ground is found to rise sharply from Merga and Wadi Hussein without any indication of the presence of further depressions. It is likely that Bir Bidi, too, may be identified with the Oyo-Wadi Hussein Depression. For according to Dr. Ball, the Prince's guides, pointing eastwards after leaving Merga for 'Uweinat in 1925, indicated the direction of a well nearby which they said was discovered by a man named Bidi. But the Prince, having located and explored the main Merga Oasis, and thinking this to be but an outlying well, passed on without visiting it. Unfortunately Dr. Ball only heard this from the Prince afterwards. But now that the Wadi Hussein Depression has been traced westward by us to within a mile or so of the Prince's route, Dr. Ball's story seems to assist in the killing of Bir Bidi as a separate entity.

We cruised round far to the north-west and north of Merga without seeing any indication of another depression. The land is all more than 200 feet higher than Merga or Wadi Hussein, but we certainly did cross a very rocky plateau rising to 2000 feet in altitude where several small dried mud pans contained dead vegetation.

We now headed due east for the two oases of Laqiya, meaning to strike Laqiya Arba'in, but owing to the whole group being wrongly placed on the map we met the tracks of Colonel Wilson's 1930 car reconnaissance from Dongola, for which we were looking, not, as we reckoned, just south-west of Laqiya Arba'in, but actually south-east of Laqiya 'Umran. The chain of depressions containing the Laqiyas is a complicated series of winding gorges opening out into amphitheatres surrounded by cliffs 200–300 feet high. Some of the rock scenery is very fine. We actually arrived at Laqiya 'Umran thinking it was Laqiya Arba'in, and it was some time before we discovered our mistake. A good series of observations were taken by Shaw and Paterson for both longitude and latitude at Laqiya 'Umran and for latitude at Laqiya Arba'in which, combined with an accurate dead-reckoning between the two, should fix the true positions of the elusive Laqiyas fairly well. The whole group must be moved about 13 miles to the north-west and with it a large portion of the track of the Arba'in Road between El Atrun and Selima.

From the pool at Laqiya Arba'in the tracks and skeletons of the old road lead north-east up the head of a gorge almost blocked with huge sand drifts. I do not think there is much chance for cars to follow this very steep ascent, nor indeed for any easy car road to be found up the northern cliffs. We eventually succeeded in finding a possible route up the cliffs to the south-east of the depression and rejoined the Arba'in Road after an exciting bit of mountaineering with the cars round the eastern crests of the cliffs.

The Arba'in Road is here fairly distinct. It runs northwards through a difficult country of boulders, roughly following the line of big solitary *barchan*

dunes. North of Camp 52 the surface improves and soon becomes a flat sand-sheet in which the remaining signs of the road are lost. We left Laqiya on the afternoon of November 17 and reached Selima the next day, 150 miles. An easy run of the same distance the following day, the 19th, brought us to the banks of the Nile at Wadi Halfa, where we received every kindness from the Governor and the other residents. The whole journey from El Fasher amounted to 1100 miles.

The party broke up somewhat at Wadi Halfa. Prendergast left us to take up his new appointment with the Sudan Defence Force, taking one of the cars with him. Sandford and Finlaison also went south. The remainder of the party, after taking another 30 gallons of petrol on board each of the three cars, set out on November 22 for Cairo. The shortest and quickest route from Wadi Halfa to Cairo lies *via* Bir Murr and thence along the Arba'in Road to Kharga and on to Asyut, a distance of some 650 miles. But we decided that having travelled so far over new country we might as well try another new route back to Cairo *via* Bir Murr, Dakhla, and Bahariya. This was now possible since the Egyptian Government had just completed the construction of an ascent suitable for cars up the otherwise impassable limestone cliffs of the Kharga-Dakhla escarpment, to enable cars carrying the produce of Dakhla Oasis to reach the Nile direct along the old Darb el Tawil.

We covered the 300 miles to Dakhla without incident in three days. The new pass is a remarkable piece of work, but several of the pitches are still too steep for loaded cars to ascend without much pushing. From the top of the main pass we followed Mr. P. A. Clayton's tracks as far as the second scarp 60 miles farther north up which he has recently made another pass. Thence we struck out due northwards over a stony plateau containing several little clumps of scrub growing in small mud pans. At the top of the second pass the surface is scoured for several miles by vertical-sided water runnels suggesting very heavy rains not long ago. We reached Bahariya on November 27 and arrived back in Cairo on the 29th.

The whole journey totalled over 6000 miles, including the two runs from Kissu to Selima and back. Of this distance more than 5000 miles was over new country with no existing tracks. Much of it was very bad going for cars, being covered either with large stones and boulders, or, in the south, with hidden water runnels of hard mud. Apart from the cracking of one main engine-supporting bracket, which occurred within sight of the Tibesti Mountains and which was partly responsible for our decision not to go farther west, no serious fault occurred to any of the four cars, which at times were twisted and bumped about unmercifully. I would like to emphasize here that were it not for the great reliance which can be placed on these cars when driven and looked after by a party with real knowledge of their insides, no such small expedition as ours could safely penetrate far into the desert with but four cars and practically no load of spare parts.

Apropos of the size and cost of desert expeditions, it often astonishes people when I tell them that the gross cost per member of this type of expedition works out at about £20 to £30 per thousand miles, without allowing for any rebates, such as the proceeds of the sale of the cars afterwards.

5. SAND AND SAND-DUNES

In the Libyan Desert the free interplay of sand and wind has been allowed to continue undisturbed for a vast period of time, and here, if anywhere, it should be possible in the future to discover the laws of sand movement, and of the growth of dunes. Since we have now visited all but the north-western portion of the Libyan Desert, a brief summary of the sand-forms as a whole may not be out of place.

Desert sand is composed of hard mineral grains which are not easily fractured by impact. The grains are small enough to be moved about by the wind and yet large enough to prevent their suspension for long periods in the air and consequent dispersal as dust. In the Libyan Desert the grains consist almost entirely of quartz. They are driven by the wind sometimes for great distances over bare ground. Then, in certain spots which, except in the case of sand-drifts, have no obvious peculiarity to distinguish them from the ordinary landscape, the grains congregate to build up definite features which can be classified under four distinct heads:

Sand-drifts or Sand-shadows; Dunes; Whalebacks or Undulations; Sand-sheets.

Sand-drifts

Of the four classes of sand accumulation, these alone appear to be capable

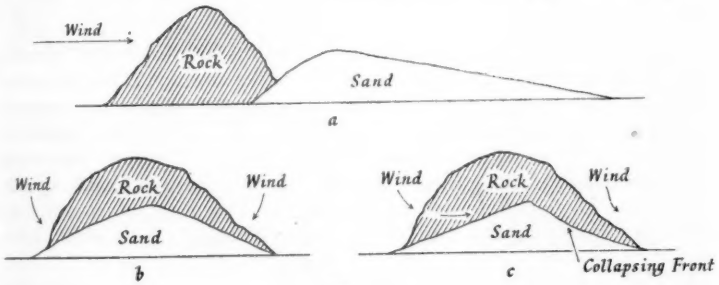


Fig. 1

of an obvious explanation. Sand driven by the wind will settle in sheltered places, gradually filling these up till the sheltered ground area is all occupied. In the case of a rock or solitary wind obstruction, a streamline sand-shape will form on the leeward side of it, provided the wind is laden with grains.

The size of the drift is limited by the area of ground over which the wind is prevented from sweeping, *i.e.* by the size and shape of the turbulent space behind the obstruction. The drift has no separate existence. If the rock is removed, the drift disappears. Fig. 1 (*a*) shows a section of a drift caused by a rock, viewed from the side. Fig. 1 (*b*) is a section looking up-wind, assuming the wind direction is constant. If the wind veers slightly, the drift tends to veer with it, and the ridge, veering faster than the base, will, if conditions are suitable and the drift be on a large enough scale, topple over, forming a "collapsing front," down which sand will slide. This is shown in Fig 1 (*c*). The steepness of the collapsing front is practically the same for all kinds of

sand, being about 33 degrees with the horizontal. No sand slopes can be steeper than this. Once the collapsing front is formed, the ridge, instead of being rounded as in Fig. 1 (*b*), is now a sinuous knife-edge.

It should be noted that the crest and general length of the drift lie roughly in the direction of the wind.

Dunes

Dunes are mobile heaps of sand whose existence is independent of either ground form or fixed wind obstruction. They appear to retain both their shape and identity indefinitely, and so to have an interesting life of their own. Contrary to common notions, there is no evolutionary connection between a sand ripple and a dune. The former is never more than a few inches in size and is merely a surface phenomenon, whereas it is doubtful if the latter is ever smaller than 20 feet across. There appears to be no upper limit to the size of a dune.

A good deal of confusion exists between a " dune," a "line" or "range" of dunes, and a "dune belt" or "dune field." A "dune" will here be taken to mean the smallest unit showing the type-form. There are two distinct type-forms. They are alike in possessing (1) a single summit, and (2) a collapsing front. In both forms the boundary between the dune and the ground on which it lies is very distinct. The sand gives the impression of having been swept up into the dune heap with a broom.

Type 1. The *seif* dune:

The individual *seif* dune has a form very like that of a sand-drift behind a rock, as just described. Its length or axis lies in the direction of the prevailing wind, and its long crest is a knife-edge ridge, one side of which is rounded and the other falls abruptly as a collapsing front. As with the sand-drift therefore the collapsing front faces a direction at right angles to the line of the dune and to the prevailing wind. The side on which the front occurs depends on the side to which the wind has temporarily veered out of its prevailing direction. The whole aspect of a *seif* dune may therefore change within a few days.

It is rare for a single *seif* to be found by itself. Normally these dunes grow end to end down-wind to form a range or line of dunes, all of exactly the same size and separated by the same interval between their summits. The interval varies with different ranges of dunes and may be anything from 60 to 600 feet. The range of *seif* dunes has one continuous ridge connecting the whole chain of summits, and this is its main distinguishing characteristic. Although the ridge may wind in curves between one summit and the next, the line of summits is amazingly straight. It is common for a single line to run unbroken for 40 miles or more without deviating more than one or two degrees from the axis joining its head and tail. Single lines of dunes over 60 miles long have been met with in the Sand Sea. Summits over 300 feet high above the base have been measured.

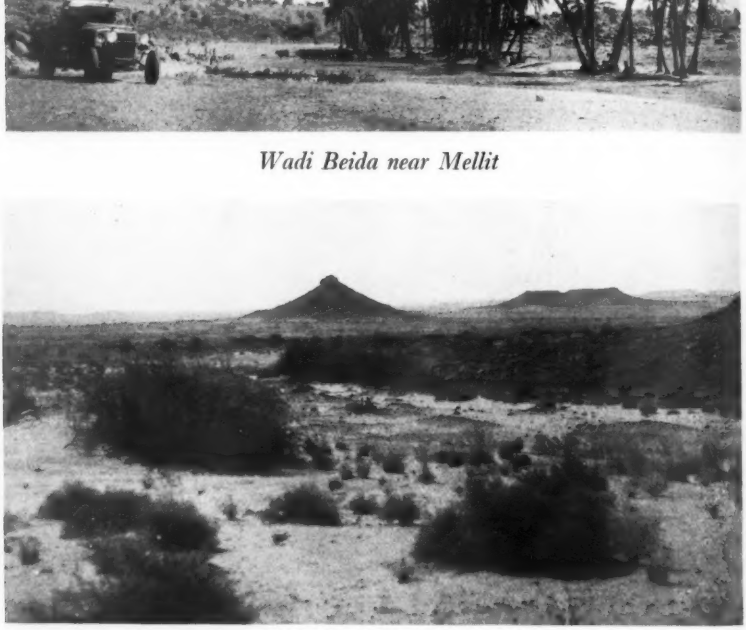
The line appears to grow by the formation of additional dunes at its leeward end, but very little information is available on this point. Nor is the rate of advance known with any certainty. Several observers hold that the advance is speeded up by the disturbance of the ground in front by car tracks, etc. As

Sub-desert country north-west of Katum

Inside the Malha crater

The Malha crater

Wadi Beida near Mellit



Remains of Nubian sandstone ridges in the country north of Malha

Salt pan at Bir Natrun

all the observed dune lines have been thus interfered with, it is difficult to guess at any rate for a dune line if left to itself. There is ample evidence of roads and car tracks having been pushed several hundred yards down-wind since 1920 by the advancing heads of the dune lines in the northern areas. There are three movements to be considered: the rate of advance of the head of the line, the rate of movement, if any, of the individual summits, and the mass-movement of the sand grains themselves.

It is usual for several *seif* dune lines or ranges to run parallel to one another, forming a dune field or dune belt. Here another type of repetition occurs, for each line is separated from its neighbour by a constant distance so that the landscape consists of a series of uniform parallel corridors. The distance between ranges varies in different areas, and may be anything from 400 yards to 5 miles. The floor of the corridor may consist of solid ground, either rock or shingle, or of undulating accumulations of sand.

Type 2. The *barchan* dune:

The individual *barchan* may be described roughly as a circular dome of sand, from the leeward side of which a big bite has been taken, leaving a collapsing front in the form of a hollow semicircle. The distinguishing feature of the *barchan* is this hollow crescent-shaped front, which faces directly down-wind instead of sideways as in the case of the *seif* (see Fig. 2).

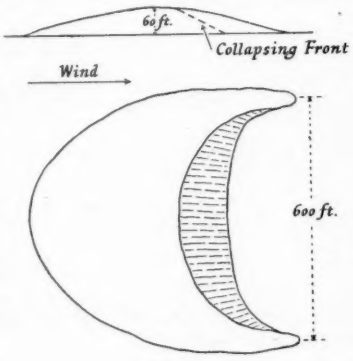


Fig. 2

As with the *seif* dunes, *barchans* congregate together. But owing to the transverse nature of the dune, no continuous straight ridge is possible, and a *barchan* line will be broad and ragged in configuration.

The dunes are usually arranged in echelon, sometimes so close together that the summits merge into one, the individuals being distinguished only by their crescent fronts, as in the left-hand side of Fig. 3. As with the *seif*, the *barchan* dune line stretches out in the direction of the prevailing wind. The line starts at the tail or windward end in the above close-packed manner, the individual dunes being of even size and evenly spaced, but the spacing increases towards the down-wind end till the individuals separate altogether. The line now carries on for a great distance as a well-drilled column of troops keeping regular echelon formation. The size of these individuals is of the order of 40 to 70 feet high and 100 to 400 yards wide between the horns of the crescent. The interval between dunes may be several miles. Sometimes a little dune 20 feet or so in width is found a few hundred yards to leeward of one of the horns of a big dune, as if some sort of reproduction is taking place.

A feature of the *barchan* is the tenacity with which it maintains its shape even when confronted with a formidable obstacle such as a small cliff, a village, or an area of rocks and boulders.

Curious cases of transformation occur. Although in the majority of *seif* dune lines the rear windward end rises abruptly to its full height in the open desert, there are some instances of short *seif*-like lines which seem to have started as sand-drifts under the lee of small hills and cliffs or even of mounds of vegetation, and crept out beyond the original sheltered area. But these lines never grow to any size. They are common near the oases of El Atrun, Merga, and Laqiya. More interesting are cases where the dunes at the head of a *seif* line suddenly alter their shape to rounded domes, and, less than a mile farther down-wind, separate out from one another, spread sideways to an echelon formation, and finally develop the typical *barchan* crescent. Instances of this can be seen north of the Gilf Kebir and at our Camp 21, 100 miles north-west of Tekro. In the depressions of El Atrun, Merga, and the Laqiyas there are cases of double transformations in which sand-drifts, starting at the foot of the cliffs, stream out across country for a mile or more as small *seif* lines and then change into true *barchans*. Apart from this, the *seif-barchan* transformation seems to be confined to the extreme down-wind ends of long *seif* dune fields, and is a sign that the field is coming to an end. The *barchans* continue only for a short distance before fading away into mounds and vague

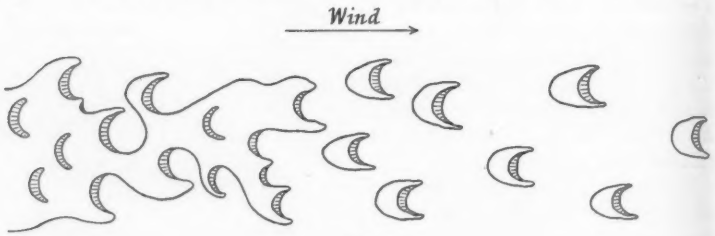


Fig. 3

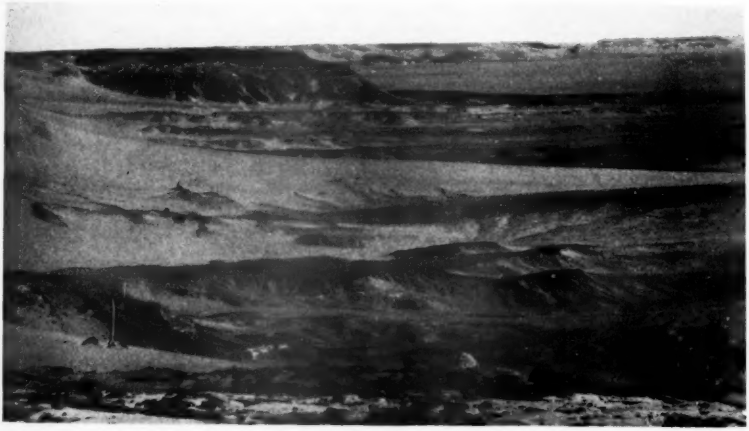
undulations. No single case has been seen of any change in the reverse direction from *barchan* into *seif*.

The general effects of changes in the surface of the land on the dunes as they advance are difficult to determine. An up-gradient certainly causes a check and a consequent thickening and complication of the long *seif* ranges. In the Egyptian portion of the desert there is some evidence that a rocky broken surface is inimical to dunes, but in the northern Sudan, fields of both *seif* and *barchan* dunes are occupying country which is considerably broken. I think an area of rocks and small scarps will nearly always break up the continuity both of *seif* ranges and of closely packed *barchans*, and will in general diminish the density of a dune field so that large open spaces are found between the dunes, but it seems to take a very broken country with hills and high cliffs to check completely the advance of a large dune field. There are good examples of *seif* dunes existing in broken country in the big field south-west of 'Uweinat, and similar examples of *barchan* dunes immediately north of the cliffs of Laqiya, and in the depressions of El Atrun and Merga.

It is now possible to construct in outline a dune map of the Libyan Desert. Three striking facts emerge:

(1) There seems to be a single territorial boundary separating the desert

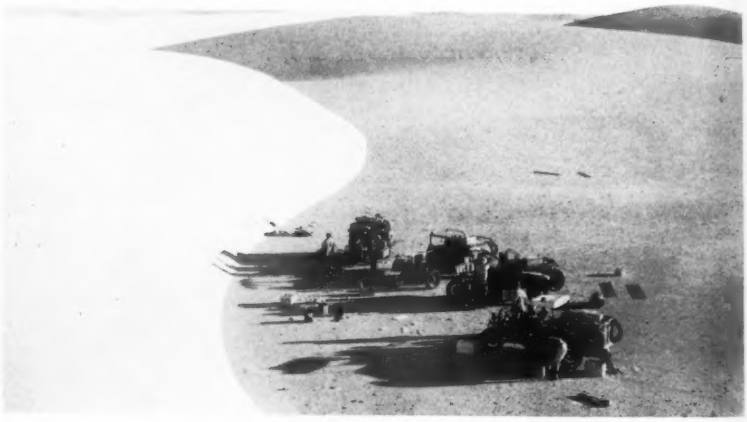
The lake at Merga



Looking east along the north scarp of the Laqiya depression

Wind-erosion of mud deposits in the Laqiya Umran depression

Selima Oasis from the south



Camp in lee of "barchan" dune near Bir Natrun

Lines of "seif" dunes in the Sand Sea

into two domains, each of which is occupied exclusively by one of the two dune types. Apart from the minor end-effects already noted, the whole of the north-western portion of the desert contains nothing but dunes of the *seif* type, while the smaller south-eastern section is reserved exclusively for *barchans*. The boundary seems to run from the Nile somewhere south of Asyut across to Kharga, and thence to Dakhla: thence south-west to the Gilf Kebir, and from there due south to meet the Wadi Hawa at lat. 17°. This boundary between dune types does not appear to coincide with any known division, either geological or orographical.

(2) All the dunes conform in direction to a single uninterrupted clockwise rotation about a centre somewhere near Kufara. The dune direction at any point on the map is presumably that of the prevailing wind also.

(3) True dunes appear to terminate about 100 miles before reaching areas where the rainfall is frequent enough to support grassy vegetation on the sand.

Whalebacks, and Undulations or Billows

A whaleback is a flat-topped ridge of sand anything up to 100 miles in length, of the order of half a mile wide, and up to 100 feet high. Like the *seif* dune range, it runs peculiarly straight throughout its length, but collapsing fronts are absent. The greater whalebacks are confined to the Sand Sea, of the northern portion of which they form the basic structure, the *seif* lines here being ranged along their backs intermittently.

Undulations are similar formations, but are shorter and therefore less definite in shape. They form the billowy surfaces between the whalebacks and *seif* ranges in the Sand Sea and in the big dune field south-west of 'Uweinat. Though so short that their general direction is often difficult to trace, they have a very uniform repetition distance of the order of 200 yards. They cover a very great area around lat. 18°, long. 25°, and thence south-east towards the Teiga Plateau. The big sand *gozes* of northern Darfur and Kordofan may possibly be of the same type. Both whalebacks and undulations appear to be "dead" or non-mobile as compared with dunes.

Sand-sheets

Except for small patches in the northern areas, sand-sheets are confined to the Nubian Sandstone country. They are characterized by their extreme flatness and by the almost entire absence of feature upon their surface, other than a fine ripple. The largest yet found lies due west of Selima, where it covers at least 20,000 square miles of country. Smaller sheets were found south and south-west of 'Uweinat, north of Tekro, and between Dakhla and 'Uweinat.

In addition to these four forms taken up by accumulations of real blown sand, there exist, especially in the Nubian Sandstone country, small objects which I will call "Grit-waves," since the presence of very large sand grains or small pebbles, too massive to be carried by the wind, is essential for their formation.[1] They occur either in sand-submerged areas, or by themselves on the surface of flat mud pans. Their shape is distinctive. They resemble giant ripples of the leaning-forward variety, *i.e.* with steep forward or down-wind slopes and gentle reverse slopes. The coarsest of the grit is collected along the crest of the

[1] See illustration *Geogr. J.*, July 1931, vol. 78, facing page 21.

wave, having evidently been driven there by a bombardment of small flying sand grains. In sand surfaces these waves occur either as raised structures whose bases are level with the sand surface, or as residues between hollowed-out troughs in the sand. Their chief distinguishing feature is the accumulation of coarse grit or pebbles along the crest. In size, these waves vary from a few inches in height to a maximum of about 2 feet. They are usually very firm and unyielding, and wave-infested areas present serious obstacles to motor transport.

[*The remaining sections of Major Bagnold's paper and a number of appendices will be published in the Journal for September.*]

DISCUSSION

Before the paper the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: Homer speaks of the Libyan Desert as being a land of great fertility. That must have been long before his time and vague perhaps as the place and the date of his own birth. Whatever were the conditions in prehistoric times, it is safe to say that the climatic conditions in the Libyan Desert have not changed in the last four thousand years. Its history, to which I will refer later if opportunity offers, is of very great interest. In the last fifteen years it has been visited frequently. Hassanein Bey has been there often; Dr. John Ball, Prince Kemal el Din, who died last year and whose death was a great loss, Miss Caton-Thompson and Miss Gardner, and the Claytons. Lady Clayton, who is here to-night, came back only a few days ago.

This is the third journey that Major Bagnold has made into the Libyan Desert. Of the other two, one in 1929 and one in 1930, he gave descriptions which appeared in our *Journal*, and he has also lectured on them. Major Bagnold is a man who knows his business and chooses his men with a judgment that ensures success and really scientific production of what he discovers. It was therefore with great confidence that we were able in this Society to support him, both financially and by the loan of instruments. One of our Fellows, Mrs. Patrick Ness, with characteristic generosity, also helped him in his work.

Major Bagnold is not here to-night, having had to go to China to attend to his duties there. His paper will be read by Mr. Shaw, who accompanied him on this last occasion, as he accompanied him before. Mr. Shaw studied forestry at Oxford; he was then in the Sudan Forestry Service and left there, he tells me, because there were no more forests in the Sudan! Since then he has been working on archaeological explorations in the Near East. He made two previous journeys in the Libyan Desert, and on this journey he occupied himself chiefly with the survey and with the archaeology.

Mr. W. B. K. Shaw then read the paper printed above, and a discussion followed.

Dr. K. S. SANDFORD: From the slides that you have been looking at for the last hour you have probably gained the impression that the Libyan Desert, or at any rate the Southern Libyan Desert, is made up mostly of blown sand, or sand that will blow, or sandstone. That is sometimes regrettably true; but at the same time there is in fact an enormous amount of geological information to be gained from this country. Indeed it is in some parts a geologist's paradise, or it would be if he could stop there long enough. The difficulty is to maintain a party in some of these isolated pieces of country for any considerable time.

It is rather difficult to present many of the geological and pseudo-geological

results of this expedition in a few minutes, but I will turn your attention to about three different aspects of the results of our work. The first is that which is much beloved by geologists—the series of geological events. We were fortunate to be able to build up a fairly complete account of the series of strata and the geological events.

The oldest beds are of course extremely old. They are Archaean or pre-Cambrian, and they form the floor of the western part of our area. Great peaks like Kissu, the western half of 'Uweinat, and some other districts made of granites, rise above, and have not been folded into, that very ancient series: it is difficult to fix their age, but we know they also are exceedingly ancient. Following them came very interesting sandstones, containing Carboniferous plants, which rather recall to memory the geology of Sinai. Those plants were found by Prince Kemal el Din's party and, based on their observations, suggestions were put forward that a large part of the sandstone of the south-western territories might, in fact, be Carboniferous. It does not seem to be so. We were able to collect from the sandstones, which are marked off by structural lines, from another and widespread group that you have been seeing on the screen. I think we can say, fairly conclusively, that by far the greater part of this younger or Nubian series is of Mesozoic age.

The last geological event was the creation of explosion craters such as Malha, and the group found from the air by Sir Robert Clayton. They are so fresh as to seem to be comparatively recent. Both are associated with great outpouring of lava; denuded stumps of volcanoes were also found at and near Sandara. It is a little difficult to say quite how old they are, probably older than they look.

Another point that I would like to present to you is this: that all round the southern edge of the Libyan Desert exist the frayed edges of a great tableland or plateau. You see it in 'Uweinat itself; certainly farther north and also in Tibesti; in the fringe of the hills to the south and in the high country round the Teiga Plateau, and you can follow it to the Nile. In other words, the Southern Libyan Desert seems to be contained within a great rampart of sandstone plateau that apparently had uniform upper surface. No doubt water and wind erosion have both played a part in this dissection.

And that brings me to the final point: the presence of sand sheets. There are a number of these vast seas of absolute flatness. The term "sand sheet" describes them fairly well but not completely. They are, in fact, surfaces of maximum desert denudation: here and there a little rock sticks out, but as it is eroded a little more the hollows tend to be filled up. I think the best term for them would be desert peneplains. I cannot imagine that much more could happen in these areas so long as aridity continues. It is probable, I think, that the desert started to grow in the regions of the sand sheets and that they grow outwards and have a tendency to join up. Between them still lies desert country which has not been, one might say, completely digested. Palaeolithic man lived within those undigested areas and his implements are rarely seen within the sand sheets. As time progressed, he lived, generally speaking, on high ground, and we have been able to trace his battle with increasingly adverse conditions and, finally, his withdrawal from the area. One of the most remarkable things that I saw in the whole expedition was the extraordinary concentration of late Middle Palaeolithic implements in the Laqiya depressions. Man seems to have been packed into that small area rather like sheep. He could not live outside at that particular time. His implements are amazing in their abundance, which exceeds any concentration that I have ever seen in the far more habitable Nile Valley. One of the disasters to the human race in this part of the world is seen in the concentration in an area and, finally, in complete withdrawal.

The Hon. FRANCIS RODD: There are two points about this evening's paper, which I think is sufficiently remarkable to mark a very interesting evening. The first is this: I remember seeing a few days ago a map, produced by *Petermanns Mitteilungen* in 1913, of the Libyan Desert, as it was then known. The article which it accompanied made plans for the exploration of the Libyan Desert as being one of the least-known areas in the world and one which was yet so close to civilization as to be possible to explore, as they then thought, with comparatively small means. At that time the only known route that had ever been traversed by a European was that by the German expedition to Kufara, which was designed to go through Ennedi to Borku, and certainly had political ambitions. That expedition never went beyond Kufara, and until after the war and for many decades later the Libyan Desert remained as unknown as the Empty Quarter of Arabia did until last year, for there were two Empty Quarters in Africa. The Libyan Desert was probably the largest. The next largest is out in the far west on the Atlantic coast.

Nothing was done in the Libyan Desert until the experience and the technical knowledge which were acquired during the war, both of camel and motor travel, made it possible. But since 1920—in thirteen years—the area which you have seen illustrated has been practically completely traversed, and most of the work has been due to Major Bagnold, the Desert Frontier Forces, and the Sudan officers in the south. They learned their trade during the war, most of them in North Africa, and I for one must admit, perhaps a little regretfully, that in that particular work modern technical means of motor cars and aeroplanes have rendered it possible to do what the camel could probably never have done.

Of the three areas of which Mr. Shaw spoke two have now yielded, not their secrets, because they have not really any secrets, but their characteristics to investigation as the result of Mr. Bagnold's journeys. The third one is also yielding its characteristics and features to an expedition,which has just returned, by Mr. P. A. Clayton and Lady Clayton. That is the first point: that one very large area has ceased to be unknown, thanks to these journeys. It was one of the largest and was certainly one of the unknown quarters of Africa.

The other point is most interesting of all, and we shall hear more about it when the paper is published, that is in connection with the inhabitation and the various people who live in the Libyan Desert. Mr. Shaw spoke of rock drawings and possible association with the Palaeolithic period. In my experience rock drawings run down through many centuries, probably through many millennia. They are extremely difficult to date, and it is only when they have been collected from all over North and Central Africa, perhaps right down to South Africa, and somebody has worked on them for a very long time, that it will be possible to describe the people or associate the drawings with those who made them. I think and hope that something will be done in that way shortly, and the Libyan Desert is probably the most important area in Africa for investigation in that particular direction, since some of us think that a great part at least of these drawings are due to a Mediterranean people that came down from the north coast towards Equatoria and ultimately found their way either west or south, or both. It is that aspect which I for one would like to see looked at as soon as possible, because it happens to have a great personal interest for me.

The PRESIDENT: Mr. Shaw, it will be my pleasant duty to-morrow to write to Major Bagnold and tell him that he has had a most admirable vicar. Without making comparisons I do not know when we have spent a more interesting evening. Major Bagnold has made use of those modern instruments that Mr. Rodd spoke of in the proper way. He has moved from place to place with

rapidity, but when he has got there he has not hurried. He has done his work very thoroughly.

I had put together one or two notes which I have got not on the desert but from the Library upstairs. Most of those points have however already been touched on, but there are one or two to which I would refer. Though the future of the Libyan Desert as a habitable part of the globe cannot be very great, its past and its present show what an immense interest it contains. There are signs that there were many more routes across the desert than there are now, and that each was much more used. That may be owing to the fact that trade is much diminished in those districts. For one thing, there is no Slave Trade, which no doubt at one time occasioned a great deal of road-making; and it is also possible that the Libyans, as distinct from the Arabs, were more successful road-builders, builders of wells, and finders of water than the Arabs.

Those interested in the history—and here I speak with diffidence in the presence of historians—might well read the description by Herodotus of an expedition which was made by five young men across from Cyrenaica to the Upper Nile, and there is also mention in Pliny of many Roman expeditions. The abandonment of these routes came from historical reasons, probably conquest and the like. It is also a fact that the sand seems to drift up extraordinarily quickly. Mr. Shaw told me this evening that one place, re-visited after three years, was found to be 6 feet deep in sand.

A study of Dr. Ball's 'Problems of the Libyan Desert' will show how much there is to be found in these places. There have been many searches after that lost oasis that we hear of. I have already mentioned that Lady Clayton, who has been for some weeks with Mr. P. A. Clayton in the Gilf Kebir, has returned, and we shall hope to hear from her, and also later from Count Almásy who is now out in that part of the world, and from Squadron-Leader Penderel, much more about it. Of the greatest possible interest will be Major Bagnold's paper itself in full and the appendices which will be attached to it.

There are many present this evening who could tell us a great deal, but time is the destroyer of much pleasure. We have to come to an end. I do so by asking you, Mr. Shaw, to accept, on behalf of this audience and the Society, and also, I may say, on behalf of Major Bagnold, our very great thanks for an evening of really intense interest. I can assure you that the admirable work done by your leader and by each and every one of his companions has been a source of great admiration to all of us.

SOIL EROSION IN AFRICA: *A paper read at the Afternoon Meeting of the Society on 8 May 1933 by Mr. C. W. Hobley on behalf of*

A. M. CHAMPION

SOIL erosion is in reality but one of the aspects of a more general problem with which the world is now being faced, namely soil deterioration. Erosion too is but one of the processes of nature which are continually in operation and cause the topographical changes which have been taking place from the very earliest geological times. In some parts of the world this action is taking place so rapidly that soil productivity has been adversely affected; it is then generally spoken of as accelerated erosion. One of these places is the continent of Africa, where though it has been progressing rapidly for many generations, of recent years, owing to the settled conditions attendant on European rule, it has become of urgent importance and is now recognized as a vital problem with which the human race has to deal.

In the Dark Continent the forces of nature, which often operate with great violence, have now for generations been assisted by the hand of man in this work of erosion. Until recently the human inhabitants were not sufficiently numerous in Africa to bring about a crisis, but they have now increased by natural processes, by peaceful conditions and immigration; more is thus demanded of the soil in order to produce the new materials of which the world is in need, as well as for the food of the ever-increasing population. It is not therefore unnatural that the subject is now occupying the attention of many administrators representing the various Governments which are responsible for the indigenous population, as well as for colonists of their own race who are seeking to make a living out of the African soil.

As far back as we can penetrate into African history we find one continuous story of movement and migration from one part of the continent to another. Such movements, whether sudden and accompanied by murder, battle, and sudden death, or slow and peaceful, were generally in search of fresh land for cultivation or pasture when their own had become exhausted. But they left their trail behind them, and enormous areas of Africa have been laid waste past all recovery, except perhaps with the assistance of man. It was hardly to be expected that native tribes, all at a low stage of culture, should lend their assistance towards restoring what they had destroyed. It is not likely that such an idea would ever cross the savage mind, especially when there was what seemed to them unlimited land yet untouched.

During the course of travels through Africa extending over twenty years I have had the opportunity of visiting a large number of the more recently abandoned areas, and whilst stationed for three years in the Nyika foothills which lie behind the towns of Mombasa and Malindi in the Colony of Kenya, I witnessed this process of destruction and its effects upon the soil productive capacity of the area. Later I had the exceptional experience of being posted to administer an area in the Ukamba Reserve after an absence of nearly twenty years. There I found that the people, their cultivation and their stock had to a very large extent moved elsewhere. Areas which had been thickly populated had become exhausted, and areas which had formerly been uninhabited bush

were found dotted with little villages and patches of cultivation. The appearance of the exhausted areas will be described below. What I saw there a year ago in Ukamba convinced me of the correctness of recommendations restricting and controlling the movements of the Nyika tribes made seventeen years before.

Beyond doubt it is now the duty of all administrators to invoke the aid of scientific specialists to ameliorate the state of affairs. Much careful investigation and experimentation has recently been undertaken by Dr. W. C. Lowdermilk, of the University of Nanking, and the results obtained should be of the greatest value to any one seeking for a solution of the problem which at present confronts Africa. It is however not as a specialist that I am attempting to approach the subject in this paper. I feel however that observations extending over twenty years of travel in Africa, during which it has been my duty to take a practical interest in all such matters which have a direct bearing on the native peoples, over whose welfare it has been my good fortune to watch, may have some interest.

There has been undoubtedly during the last two thousand years a very great increase in the population of Central and Southern Africa. It is not suggested that this part of the continent is even now as densely populated as many other parts of the world. Conditions however in Africa are different from those in many parts, where increased density has stimulated the development of improved technique, for the Africans seem to have remained static: the increased population demands more from the soil, and yet knowledge regarding its preservation has not progressed. Field and forest have all along had to supply all their domestic wants—food, fuel, building material, clothing, furniture, weapons, kitchen utensils, and pasturage for their stock.

And now at this very moment we receive assurances that we may expect during the next generation an unprecedented increase in native population due to our efforts in promoting public health. Still greater demands may be expected on the soil not only for the needs of the indigenous population, but also to supply the raw materials for the export market. If we fail now to recognize the importance of this problem we shall most assuredly have it forced upon us in a most unpleasant manner in the near future.

The causes of accelerated soil erosion

On a little reflection one finds these to be more numerous and divergent than one was led to suppose. One is inclined to say that it is just earth being washed away by the rain, that it collects somewhere else and supports a vegetation either cultivated or uncultivated in its new position. This is a comforting theory, but it is far from correct.

It is proposed therefore to tabulate those factors which are considered to be the more important and to discuss and offer remedies for them later, in that order:

1. The nature and physical structure of the soil.
2. The formation and geological structure of the underlying rocks.
3. The gradient on which soil rests.
4. Atmospheric conditions.
   (*a*) Rain.

(*b*) Extremes of temperature.
(*c*) Prevalence of high winds.
(*d*) The existence of a definite wet and dry season.

5. The existence or absence of a mantle of vegetation and its nature.
6. The nature and extent to which the land is cultivated.
7. Overgrazing by stock.

1. *The nature and physical structure of the soil.*—It is obvious to the least observant that certain types of soil erode more easily than others. Clays set firmly and are not easily washed away; those less heavy in texture and more easily permeated by moisture break up or disintegrate and are readily transported by the agencies of denudation. Many sandy soils have little bond in them, the finer particles are dissolved or are leached out and the grains of the sand thus released offer but a poor soil for the support of a vegetable covering, and so the area becomes devoid of vegetation or assumes desert conditions. The former may be carried in solution or suspension to the sea by the swift-flowing rivers which are a characteristic feature of the African continent, whilst the latter being heavier soon sink as the force of the current decreases, and thus silt up the river courses often to a depth of 30 or 40 feet.

The soil of an area is largely derived from the underlying rock, and as the major portion of the African continent consists of either granites, gneisses, or recent volcanic lavas which often denude more rapidly than other rocks (*vide* Report on Erosion Control in Japan by W. C. Lowdermilk), it is not surprising to find that Africa as a whole is suffering more from accelerated soil erosion than perhaps any other continent of the world. Another type characteristic of Africa is known as Black Cotton soil; it is largely derived from decomposed felspar, and when dry sets so hard that it can only be broken with a pick; it is almost impermeable to water except by mechanical action. It is a soil deposited by the action of water and is to be met with in shallow basins and flat poorly drained areas. The surface during the dry weather shows a marked tendency to crack, and it is only by this means that water penetrates. Such areas often become flooded and remain so until dried by evaporation. It moreover erodes readily when, owing to physiographical changes, gutters begin to cut back into it.

Generally speaking the soil is not unfavourable to vegetable growth, but when such is removed a surface crust often forms. Once this occurs run-off is increased, and this leads to the formation of water channels and eventually to serious erosion in the form of canyons.

2. *The formation and geological structure of the underlying rocks.*—The dip of the rocks, if of any considerable angle, often exposes the outcrops of harder bands which not infrequently assist very materially in holding up the soil, conserving moisture, and preventing erosion. When however in sedimentary series the dip is coincident with the normal level of a mountain slope erosion is thereby accelerated and the soil slides either by a slow creeping motion or in the form of land slides. Rock-faces are thus left bare. Where rocks are tilted at a high angle the percolation of water is much assisted and the underground supplies much augmented, often giving rise to springs which minimize the effects of drought on local vegetation. Jointing too in all rocks facilitates erosion.

3. *The gradient on which the soil rests.*—This must of necessity be an important factor, and in mountainous country it is often only by reason of a strong vegetal mantle or artificial means that the soil, no matter what its nature, is kept in place at all. In such areas the fall of the streams and rivers is rapid and their flow in consequence is very strong and capable of removing the soil to considerable distances, depositing the particles, according to their weight and size, at varying distances to form fresh deposits of gravel, sand, and soil, and even conveying some to the sea.

As mentioned above, most of the smaller river-beds in Africa are silted up with sand and during the greater part of the year are dry, when water is only obtained by digging to considerable depths. When in flood this sand is moved slowly downwards after the manner of a glacier, carrying with it boulders of prodigious size and weight. Some such rivers flow into lakes which are in consequence rapidly silted up, others lose themselves (*e.g.* the Thua River in Ukamba, Kenya Colony) in the plains distributing their sediment over considerable areas. Such areas however do not seem to have any great fertility, for the reason that successive layers of new sandy and sterile material cover the surface before humus has had time to form.

4. *Atmospheric conditions:*

(*a*) *Rain* is of course the main agent in denudation or topographical sculpture, but its intensity more than its quantity brings about the accelerated erosion which is now under consideration. When rain falls more heavily than it can be absorbed by the soil, "run-off" takes place and, except on horizontal surfaces, erosion results, and growing in volume carries the soil down with it to the streams and rivers. Africa is a land subject to violent rainstorms; an inch or more of rain may fall in an hour. In that hour thousands of tons of good soil are lost for ever.

(*b*) *Extremes of temperature.*—It is thought that the alternate heating and cooling of soil tends to disintegrate it and thus reduce its resistance to the other agencies of erosion. Certainly the fierce rays of the African sun often completely dry up the vegetal mantle and the consequent extra heating of the soil causes a further loss of nitrogen as well as exposure to wind and rain.

(*c*) *The prevalence of high winds* to which Africa is prone tends to dry up the soil, carry it, where loose, to great distances, scatter seeds, and stunt vegetation. It is probable however that the action of wind as an important factor in the problem is limited to desert areas already bare of vegetation where dust- and sand-storms are common, or to the imparting of additional violence to rainstorms beating against a hillside. Many examples may be seen where the windward side of the hill has become severely eroded whilst the sheltered side remains in a normal condition.

(*d*) *The existence of a definite wet and dry season* is usual over a large part of Africa, and this is undoubtedly a factor to be considered. In other countries where the rainfall occurs throughout the year the soil remains in very much the same condition of moisture. A continuous downward action is taking place except on the rare occasions when for short periods the surface becomes dry. In Africa the long droughts result in a wilting of the vegetal covering, a drying and crumbling of the surface of the soil, so that when the rain comes, which it often does in the form of a violent storm, there is nothing to prevent

the loose particles from being washed away. With the first few storms which usher in the wet season the erosion is generally much heavier than later, when the soil becomes saturated or set.[1]

5. *The existence or absence of a mantle of vegetation and its nature.*—As has already been stated there is unmistakable evidence that at one time, and at no distant date, large areas of Africa which are now comparatively bare were covered with forest. We see the hilltops and other less accessible spots still supporting fine forest growths. We see on the slopes and even on the plains the old dead roots. We have also the verbal evidence of the native inhabitants.

Beyond all doubt, if forests do not attract rain they cause precipitation of clouds and most certainly preserve moisture. The foliage protects the soil from the violence of the rain. The trees supply a covering of loam and litter which not only retains moisture but allows it to percolate more slowly downwards and be absorbed by the soil and subsoil. This litter clarifies the water so that by the time it gets through to the soil it contains none of those fine particles of mud which tend to seal the surface of a soil over which there is no such covering. The litter also provides a home for the numerous soil fauna which together with the decaying vegetable matter are so necessary for the formation of humus, and it imparts a high degree of absorptive capacity to the underlying soil. This process is one of the most important, in fact an essential one, in the supply of moisture to the subsoil. It is the faculty of soil to absorb and hold water which enables plant life to survive periods of drought and which is so necessary for the formation of underground reservoirs from which the springs draw their supply.

6. *Nature and extent to which the land is cultivated.*—Up to now we have dealt entirely with natural phenomena, tacitly assuming that nature was being allowed to take its course. Now however we have to consider what part man has played, and we shall find it is as important as it is destructive. He has set in motion forces which it will take all his brains to arrest.

From the information gathered throughout the continent it is evident that the tribes of Central and Southern Africa have been perpetually on the move, cultivating an area till it became exhausted, moving on by warlike or peaceful penetration, cultivating the newly gained land in the same way, never giving a thought to preserving the productivity of the soil, a prey to forces neither recognized nor understood. Vast areas of the Sudan, Uganda, and Kenya, and possibly many other and even vaster areas in Africa, have been deforested, cultivated, and left exhausted. Some of these areas if left for a generation or two do recover. To the African however no problem presented itself. Was there not enough of Africa to wander over? And so the great migrations southwards, westwards, and eastwards went on. Suddenly they were stopped, arrested by the advent of the white man, a sequel to the checking of tribal conquest. Now the population is increasing, the demands on the soil are more. No longer is the native content to grow enough for his personal needs; he grows surplus for the export market. Most of the forest in his Reserve has been destroyed to make room for cultivation or to provide fuel and building materials.

[1] Dr. Grantham calls attention to the cementation of the surface through the alternations of wet and dry, usually caused by the rise of water carrying colloidal clay which binds the surface.—C. W. H.

Cultivation is increasing up to the mountain sides and as quickly the soil is being washed down to the rivers. The humus, the forest litter, and the sub-soil are all being rapidly denuded away, and the native is already crying out for more land. The land which he has allowed to go fallow for a few years has neither returned to pasturage nor forest, but supports a rank vegetation of black jacks or Sodom apples. If he is driven to cultivate it, his crop is a meagre one, and should the rain be deficient, he will possibly not reap a harvest at all, for the soil has vastly deteriorated since he turned the first sod perhaps not five years before.

7. *Overgrazing by stock.*—Hardly less destructive an agent than man himself are the domestic animals he keeps for his support. Cattle, sheep, and goats, which constitute the usual stock of the African, if not systematically controlled will crop an area so closely that the grass is not even permitted to come to flower, and sheep will even pull up and eat the roots of many kinds of grass, whilst the goats will do untold damage to the trees and shrubs, which should provide a certain amount of shade and protection to the pasturage. In the Kamasia area south of Lake Baringo (Kenya Colony) I observed that there appeared to be what may be likened to a flood-line about 5 feet above the ground. The ground was bare and so were the trees and shrubs up to this line, which, instead of being horizontal as a flood-line would be, was parallel to the rolls of the surface. On inquiring, I found that this rather curious phenomenon was caused by the destruction done by goats, the height of 5 feet marking their upward grazing level. Native stock is now generally on the increase, for epidemics are tackled and the grazing is everywhere insufficient for its needs. There is in consequence a rush for new areas which have up to now stood the heavy demands made upon them, and they too will soon be depleted. Such concentration in favourable spots means much movement of herds from place to place and to and from water. In the course of time, with the trampling of hoofs, embroadening paths are made to water: these soon serve as channels for water and funnels for wind, and so accelerated erosion is started, resulting in the formation of deep dongas (see *Kenya Bulletin* No. 4/1930, "Soil Deterioration," by A. Beckley).

In the northern portion of the Kitui District lies an area known as Mumoni. This in 1909 was one of the most flourishing and populated parts of the district. To my great surprise when I revisited the place in 1930 the population had almost entirely disappeared and hardly a head of stock was to be seen. The area had been cultivated and grazed to destruction. Where there had been grass and trees and shrubs, the soil was either bare and gravelly or was hard and sealed, being intersected with numerous little water channels which, joining up with others like the veins in a leaf, carried the run-off water down to the rivers. The only vegetation was a short flat-topped variety of acacia thorn round the stems of which a few rank weeds struggled for existence. Some trees fringed the larger river-beds which were completely silted up with sand. Where water had once been plentiful it was in 1930 either absent or only obtained by digging to a great depth. The season too had been by no means a dry one. On inquiry it was found that the cattle had all gone down the Tana River or out eastwards to areas which in 1930 were uninhabited. The owners said they would rather risk the tsetse fly than see their cattle die of thirst and

starvation. If they had stayed they would probably have suffered a similar fate themselves, for such soil as remained could support no crops.

A few days later I was on a hill about midday in the middle of this area which covers approximately 200 square miles, and saw a heavy rainstorm over it, and within half an hour heard a continuous roar like thunder; looking through field glasses in the direction from which it came I saw wave after wave of red frothy water coming down the river which drains part of it. Wave succeeded wave like a rapidly rising tide until what had a moment before been a dry watercourse became a raging torrent 12 feet deep. Fearing that I might not be able to cross, I hurried down from my point of vantage to the river bank about a mile away, but was too late. Already the water, which was the colour of *café au lait*, was 8 feet deep and the current so tremendous that whole trees which had been torn from the banks were being transported along at a speed which could not have been less than 10 miles an hour. The river here at the ford was 70 yards across, and it was then 11 a.m. By 5 p.m. it was possible to cross almost dry-shod. One hesitates to estimate the thousands of tons of soil carried past in the few hours one stood on the bank watching nature completing the havoc which man had commenced. The water at first glance hardly suggests a fluid. This is but one instance of what is going on in hundreds of places throughout the continent.

To those who have lived amongst the natives of Africa it is common knowledge that the pastoral tribes at certain seasons burn off their grazing area. They give two reasons: Firstly, that the young grass comes up better if the old dead stuff is burnt off, and secondly that the ticks or a large proportion of them are killed. Probably there is some truth in both, but what is a certainty is that the nature of the grass is injured. Nature's mantle, protecting the seeds when germinating and the young shoots when tender, is removed and the ground exposed to the eroding agencies alluded to above. No humus can form, and the old roots tend to grow into coarse tufts which become accentuated as the intervening bare patches form on slopes—a type of erosion pavement not favourable to the germination of seed.

Such are the principal ways in which accelerated soil erosion is taking place in Africa. There are probably others not yet observed or recognized. The problem before us is to seek by what methods we can best arrest this erosion and reduce it to the normal. They may be conveniently dealt with in the same order.

1. With regard to the physical structure of the soil, man can but improve this from the surface either by providing the soil with the covering of loam or forest litter which it originally had, or by the application of manures, a process rather beyond the scope of this paper. An examination of the natural soil of an area is however important, as it would not be worth while undertaking expensive works to retain a soil of an unproductive nature.

2. Similarly the formation and geological structure of the underlying rocks is worthy of our study in connection with soil production, and by doing so we may be able better to select suitable soils for agricultural effort and devise the most effective means for their preservation.

3. The gradient on which soil rests is a factor which in the now densely

populated countries has long been considered, and steep gradients have been corrected by terracing. It is doubtful if as yet the time has arrived when in Africa we can consider such measures on a big scale. Regulations might be introduced by degrees, forbidding the cultivation of slopes over a certain grade (say 25 per cent.), and concentration on methods of retaining the soil by small wash stops, planting of hedges, strips of field refuse, branches of trees laid along the contour lines. Up-and-down cultivation on hillsides could be easily forbidden, whereas cultivation in transverse strips might be encouraged. Between such cultivated areas the natural covering should be left and even planted with suitable trees. It is on the commencement of the erosive processes that we should concentrate. This means educating the peasant; it will not be without difficulties, and old prejudices and age-long systems of land tenure will have to be considered; but it will be done, especially amongst the agricultural natives, and should not involve very heavy expenditure.

Big works such as the construction of check dams within river-beds, which have been undertaken in Japan, should, it is considered, be preceded by the minor works alluded to above. In fact the steep fall in the rivers in many parts of Africa renders it doubtful whether such works would be effective. On the other hand there is little doubt that if such measures as are above advocated could be extensively carried out, in a very few years they would bring about such an improvement in productivity of the soil on the gentler slopes that it would not be necessary to cultivate the steep ones.

4. As for atmospheric conditions, there is little man can do to alter or control them. He must take them as he finds them, study them, and try to turn them to the best account he can. One point however should not pass unobserved. It is that in areas where the rainfall is insufficient the more important becomes the proper cultivation, preservation, and protection of the soil, so that no run-off is permitted and the maximum percolation obtained. Further pursuit of this matter would however lead us beyond the scope of this paper.

5 and 6. Here we arrive at a point which is very much a concern of man, for he has been more responsible for removal of the mantle of vegetation than any other agency, and in many places where nature has failed it is only by the exercise of his intelligence that it can be replaced. The importance of loam and forest litter has been already demonstrated. It must be preserved and even created and retained in the places where it formerly existed if the moisture and structure of the soil necessary for the production of the needs of man and beast are to be maintained.

Prevention is better than cure. By this is meant a concentration on the prevention of forest and grass fires (in Africa very difficult to do); protection of all forest areas by the introduction of a system of control; and an encouragement of the establishment of individual fuel plantations (*e.g.* quick-growing trees such as gums and black wattles). Except in forest areas one cannot prevent the native from cutting fuel and grass, debarking trees, smoking out bees, etc., for these supply his domestic needs, but if he has a fuel plantation close to his hut he, or more accurately his wife, will probably not search for firewood on the hillsides.

In Kikuyu some ten years ago the fuel and building material problem became acute. Communal plantations were not a success. The natives

regarded them either as the property of the Government or the local chief, but when I began issuing tree seedlings in boxes to individuals, the idea took root as fast as the trees, which were hereafter well looked after instead of being neglected and pillaged. I do not recommend the wholesale planting of trees all over the hillsides; it has been found to be a very hazardous operation; it is preferable that trees be planted in lines if planted at all. The entire abandonment of an exhausted area is recommended for such a period as will allow the natural cover to reassert itself, with the assistance of minor works such as wash stops, hedges, etc. In areas denuded of grass it is believed that lanes cut across the fall of the land planted with grass seed and slightly revetted on the lower side with a ploughed line and such scrub and thorn as is cut in making the lane, would be the best method of reconditioning denuded pastoral areas.

One cannot leave this subject without a word of warning with regard to native methods of agriculture. They are too well known to need description: shifting from place to place, cutting down and burning forest so as to obtain access to fresh land when the supply of humus is exhausted, destroying the undergrowth which protected the roots of the bigger trees they could not fell. These forest giants thus left exposed in the deserted fields seldom survive many years, as their roots are exposed to the sun. Areas surrounded by forest tend to return to forest and little harm is done, but areas on the edge of forest or lying on the lower side of forest, as is often the case if allowed to remain fallow, show in their altered vegetation unmistakable signs of soil deterioration. This procedure has to be stopped, and where already indulged in, corn and green crops grown and a system of rotation introduced. As the native population increases, as in Kenya and probably throughout Africa it certainly is increasing, the need for such measures will become more and more acute; the question has moreover a political bearing, for it may be the cause of agricultural disturbances.

7. Finally we come to overgrazing or overstocking of an area, and here the recommendations made in the previous paragraph apply. In addition certain measures controlling pasturage and the movement of stock would undoubtedly prove beneficial; more important would be a reduction of the number of stock either on the basis of what is necessary for the personal needs of the native or by the killing, *i.e.* the slaughter, of all beasts which have reached their prime. If allowed to live they can only be regarded as an extra charge on the grazing. As long as the native however continues to regard stock in the light which he does (viz. currency) it is extremely doubtful if much could be quickly effected in this direction. He ought to be encouraged to sell to meat factories, but the idea does not as yet appeal to him.

There is little doubt but that with the introduction of the Pax Britannica and improved veterinary measures native stock is increasing in numbers, and will continue to do so. The problem is in truth rapidly assuming gigantic proportions, and resembles a geometrical progression.

In conclusion it must be urged that in approaching this problem and recommending immediate measures the greatest caution is needed. Methods which have proved effective in one country may not in another. The first step which is required is regulated and systematic research by men competent to undertake the work. Spasmodic planting of all sorts of trees in all sorts of places will

not prove a panacea for this evil. True in some places tree planting may be the solution; in others quite different methods will need to be adopted to arrest this accelerated erosion which is most certainly going on at a very alarming rate on the continent of Africa.

SOIL EROSION: A Problem in Human Geography: *A paper read at the Afternoon Meeting of the Society on 8 May 1933, immediately after Mr. Champion's paper, by*

C. W. HOBLEY

Mr. Champion, the author of the previous paper, has had some twenty-four years' administrative experience in Kenya Colony, and is known to me as a trained observer. As with many other officers in the service, the importance of soil erosion has for long exercised his mind, and on my recommendation he set forth his views on the matter.

In the dawn of human history man was a hunter, his numbers were few. He mainly lived in camps following the seasonal migrations of the wild herds, retiring to caves in inclement weather; at this stage he had no effect on the Earth's surface. Then came a time when he discovered that the seeds of certain grasses were edible, also certain roots, and a little later he found it saved labour to plant these seeds and roots near his hut. The care of the growing plants anchored him for much of each year to a restricted patch of country, and so agriculture came into being. He domesticated certain animals, and the food provided by these and the crops from his fields gradually caused the hunting propensity to flag from the position of necessity to that of an amusement, a spare-time occupation or perhaps an emergency for periods of exceptional food shortage.

It was at this stage that the number of our ancestors began to grow, in fertile areas, but even then the increase was slow until the digging stick gave place to the iron hoe, and so on till in some places that was superseded by the plough.

It was only then that man began to make a permanent impression on the Earth's surface, and in countries with steep outlines and periodic torrential rain the result has often been and is increasingly most destructive and disastrous.

Erosion is a geological fact, and as long as there is rain so there will be erosion, for all regions elevated above sea-level must eventually be aggraded to base-level. If man is to obtain full value out of his agricultural efforts, the pace of denudation must however be minimized, for the productivity of the soil mainly depends on the finely divided mantle of humus which contains the essential soil bacteria. When severe erosion occurs this is removed in a short space of time and its replacement is a lengthy process; further, if the removal of the soil is complete the area affected is entirely ruined and can no longer support man or beast for a long period to come.

In these isles, where the slopes are mainly gentle, where the rains are rarely torrential, and the temperature is moderate, the natural soil carpet is generally sufficient to check erosion at a dangerous rate. In much of Africa however,

where at times the rains are torrential, where the terrain is often broken, and where the soil cover is scanty, erosion is playing terrible havoc, and it is one of the tragedies of that land that the process is greatly accelerated by man.

The agricultural methods of the natives are very primitive, and from time immemorial have proved destructive to the areas which they occupy; the history of native races in Africa has been one of migration through the ages, and there is little doubt that many of such migrations have been due to the urge to leave an area the fertility of which they have ruined. It is therefore little exaggeration to say that up to fairly recent times almost every tribe has been periodically moving forward, leaving behind it an area the productivity of which has been ruined by their destructive methods. It may be too that such frequent migration checked their sociological development.

In olden times movement was only controlled by tribal hostilities; some tribes survived, others were practically annihilated and the survivors absorbed. The conquerors occupied the lands of the vanquished; it was during the periods of peace however that the damage was done, for a tribe once it settled down in a new area carried on its indigenous practice of shifting cultivation, cutting virgin forest, and leaving behind it land more or less exhausted; it was here that erosion gained the upper hand. In about the last eighty years the Southern Kikuyu in Kenya have, for example, swept away no less than 1000 square miles of magnificent primeval forest and are now upset because the Forest Department has checked this procedure, complaining of lack of access to land wherein to carry on the same policy.

A vast amount of the eastern portion of Central Africa consists of stretches of arid plains, and rising out of them are tracts of mountainous country, *e.g.* Dabida, Sagala, the Ukambani Hills, the Kikuyu ridge, Mount Kenya itself, Kilimanjaro, and Meru. All these elevated areas attract rain, have permanent water, and are naturally more fertile than the surrounding plains, consequently they became occupied by various tribes. Forty years ago, although the ravages of erosion were even then apparent, the Taita ranges of Dabida and Sagala contained much good land, but to-day they are ruined by erosion due to the destruction of forest on the watersheds, and 90 per cent. of the cultivable soil has been swept away into the arid plains. The same process has gone on in Ukamba country, and to-day it is a country of stark ridges of bare gneiss and schist, and the increasing population obtains sustenance with the greatest difficulty. In years of drought they cannot subsist at all, and have to be fed by the Government.

Strenuous efforts are being made by the Executive to encourage tree planting on the hilltops; this may do some little good, but the damage is done, the soil cover and the humus has been denuded from the slopes and myriads of goats effectively prevent its renewal. Some good souls in this country demand an increase of land for native occupation; this is however a futile solution, for it will perpetuate their ignorant practices, and now that the natives are short of land is the time to teach them to improve their methods. Necessity is the best spur.

The situation in South Africa is no better; in most places the productivity of the native reserves has been ruined, and these areas are now incapable of feeding the population. The agricultural practice of the Dutch farmer in the

latter country has often been quite as destructive as that of the native, but since the war the Union Government has taken up the question, has unceasingly stressed the grave dangers of erosion, and has advised the landowners how to cope with the problem.

In 1920 the Union Government of South Africa appointed a Commission to inquire into the best means of avoiding losses by drought, for an impression had grown up that South Africa was gradually undergoing general desiccation. It is however interesting to note that, after careful inquiry, they came to the conclusion that there was little evidence of change of climate, but that since the entrance of the European, enormous tracts of country had been more or less denuded of the original vegetation, with the result that rivers, vleis, and water-holes described by old travellers have dried up, disappeared, or only occasionally carried water. The consequent prospect is stated in very striking terms: "The simple unadorned truth is sufficiently terrifying without the assistance of rhetoric. The logical outcome of it all is 'The Great South African desert uninhabitable by man.' "

The report goes on to say that "the quantity of rainfall shows little variation; its utility however has certainly diminished, for the quantity absorbed by the soil is continuously decreasing, and for this man is responsible." This is the crux of the argument: if the maximum proportion of the rainfall is absorbed by the soil, the water table rises and the onset of drought conditions is postponed; if however comparatively little of the rain is absorbed, the run-off is excessive after a storm, erosion proceeds to an increasing extent, and—quite as important—the water table is lowered.

Deforestation has, for instance, had a deleterious effect, and the destruction of trees has in many areas been excessive. The effect of forest belts on rainfall is sometimes misunderstood; forests will not produce rain if the water in the atmosphere is not near the precipitation point and is scanty. Forest on mountain ranges, where in Central Africa it often occurs, does undoubtedly check the movement of the air currents from the sea, and if the forest belt is of some width, it cools the air to some extent, and this cooling results in precipitation, often on the far side of the range. This is believed to be the cause of the high precipitation on the west side of the great Mau ridge in Kenya, and other examples could be quoted.

Rain falling on forest is moreover checked in velocity in its progress to the earth by the leafy canopy, and this lessens its destructive force. The considerable depth of decayed leaf mould in a high forest also acts as a sponge, absorbing much water and giving it out slowly in perennial streams, instead of in quickly spent spates of torrential ferocity. The loss of soil by these quickly spent torrents on land exposed to their effect is terrific, and although very accurate information is difficult to obtain, it was estimated that in the Union of South Africa in one year 187 million tons of soil was removed.

It is perhaps invidious to point out the deficiencies of the Dutch farmer in South Africa when we find a writer in the U.S.A. describing the pernicious effects of a system of agriculture which is causing excessive soil erosion in many parts of that country. It was stated in the *Science Monthly* for November 1932 that over extensive tracts of country the productive top-soil charged with humus has been removed, causing land formerly under tillage to become derelict and

colonized only by a worthless type of vegetation. Thus in Oklahoma a survey completed in 1930 showed that of roughly 16 million acres under cultivation 13 million were subject to excessive erosion and nearly 6 million had become so deeply gullied that ploughing was no longer possible. In the semi-arid South Western States over-grazing had led to severe denudation of enormous areas of upland and consequent impoverishment of the pasture. A case is cited of a rainstorm in May 1930 in the black soil belt of Texas, where 20 tons per acre were removed on a 4° slope.

It is again reported that all the evils of accelerated denudation have been operative in the valleys in Tennessee for over a century to such an extent that much of the farm land has lost its value and must soon be abandoned. Its fertility is exhausted owing to the removal of the soil. The new President has a project for the reafforestation of the uplands in this region, the object being not so much an increase of timber resources as the checking of the collection of run-off at the higher levels, especially when the snow melts. It is found that the removal of forests facilitates rapid melting, inducing destructive floods, and so accelerating erosion.

A. Loveridge ('Reports on Scientific Results in Tanganyika Territory') states that: "Due mainly to encroachment on the forest land and the subsequent erosion, in Nyasaland, which has been longer under observation than Tanganyika Territory, it has been computed that the impoverished land will only support half the population that it did one hundred years ago. Dr. Robert Laws, resident in the country for half a century, recently stated before the Nyasa Lands Commission that so recently as fifty years ago the northern sections of the country were well wooded and supplied with perennial streams. He mentioned twenty large streams which had ceased to flow in Mombera's country to-day; they formerly flowed all the year round, prior to the wholesale destruction of the forests, which had rendered the region uninhabitable. The wild fauna, with the exception of a few adaptable species, also perishes with the forest." On the East African coast I have often observed that when the rivers are in flood the chocolate-coloured waters tinge the sea for several miles opposite their mouths.

These striking phenomena are of course not confined to Africa, and even in Europe dramatic examples of the destruction of fertile land which is essential to mankind can be seen. One of the most striking I have seen is the valley of the Ardèche in Southern France. This river has cut back a deep gorge extending for many miles into the Central Massif. Originally the area was thickly wooded; the destruction of the forest through the ages has accelerated erosion, and periodic floods of terrible intensity now occur; these floods bring down much silt, and it is estimated that some 100,000 acres of fertile land have, during the last century, been destroyed by the sand and gravel which is spread out over the vineyards by these floods.

The bare limestone ranges bordering the eastern shores of the Adriatic are probably known to many. It is recorded that these were once covered with forest; this natural covering was destroyed in mediaeval times (it is said to have provided timber for the Venetian ships), the humus has been washed away, and the whole region is now one of the most tragic examples of the conversion of good land into typical *karst* country, now quite irreclaimable.

The disastrous floods on the Hoang Ho in China are on a much greater scale than anything previously referred to, and are believed to be in a great measure due to the destruction of the forests by the Chinese, which has exposed the soft *loess* to uncontrolled erosion.

In Japan the steep topography renders much of the country susceptible to excessive erosion, and with their characteristic thoroughness the people of this land have tackled the problem by extensive works, and these will in course of years probably be sufficiently widespread to bring the danger under control.

With reference to the effects of over-grazing on this problem, attention is invited to the last report of the Director of Amani, the East African Agricultural Research Station. He states that the time has come when cattle must be, in certain areas, regarded as pests, and he goes on to compare the damage done by cattle with that done by locusts, the latter having, as all are aware, recently attracted much attention. He points out however that locust invasions only cause transient loss, whereas overstocking reduces land to desert in not more than twenty years; and goes on to say that unless the natural increase of these animals is sold off an extension of pasturage obtained by driving back the tsetse flies can provide only temporary relief and will end in opening up fresh areas to devastation. Sale to meat factories will however, on the other hand, convert what is now a liability into a valuable asset. The connection between tsetse-fly and erosion may seem remote, but advance of the tsetse into grazing country causes retreat of the cattle and over-concentration in the fly-free areas; overgrazing and consequent destruction of pasture follows, and erosion prevents its recovery.

It is never satisfactory to point out an evil without attempting to outline a policy for its amelioration. As has been shown, man is greatly responsible for the destruction of the fertility of land whence he draws his sustenance, but if human intelligence can point the way to minimize the danger, it then only remains for individuals persistently to fight the menace. The word "individuals" is stressed, for it is a problem for the individual farmer, be he European or native, being usually too widespread to be tackled by any Government. Consideration of remedies should be divided into two categories: (1) grazing land; (2) agricultural land. In both cases the remedies should, if possible, be such that they can be carried out by the farmer himself, and thus should be of a simple character. In South Africa the main problem is the conservation of grazing land, for, as is well known, at least two-thirds of the Union is too arid to be suitable for agriculture, and the question has in that country been mainly considered in the interest of the sheep farmer. In fact it is estimated that if the sheep were allowed to graze in fenced paddocks instead of being corralled every night, the grazing land at present utilized would carry about 50 per cent. more sheep, *i.e.* 35 million instead of 23 million. A word of explanation is here required. It has been found by experience that if sheep and goats are allowed to roam at will over an extent of land which is normally arid and thus has scanty vegetation, the soil cover steadily decreases, for new growth rarely has a chance of establishing itself and moreover of seeding. The daily trek of the flock from and to the corral establishes myriads of tracks which in their turn initiate erosion channels in time of torrential downpour.

Now the reason in South Africa for the assemblage of small stock every night

is the jackal, the only predatory beast which has hitherto escaped annihilation. The South African Government has on this account arranged to give loans to farmers to help them to erect jackal-proof fencing. The practice of using paddocks moreover prevents overstocking, for part of a farm is, under this system, evacuated for say a year or two and the vegetation therein has a chance of recovery. It also improves the condition of the stock, for otherwise each day the flock has to be driven an increasing distance from the central kraal to find sustenance. This double journey decreases the feeding hours of the animals.

It has also been here found to be a desirable practice to establish a number of small wired enclosures throughout a grazing farm in which the vegetation can grow unchecked, and the seeds from these natural assemblages is blown far and wide over the surrounding land.

In arid areas thorn bush generally abounds and patches of the veldt can be given a chance to recover by covering them with branches of the thorn trees;

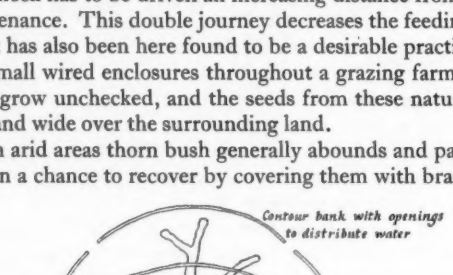


Fig. 1. Reclamation of eroded valley

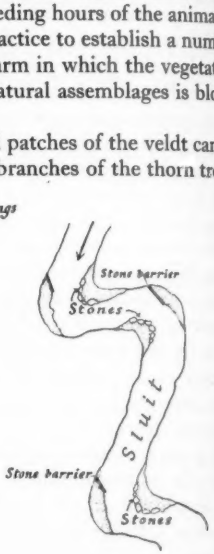


Fig. 2. Reclamation of sluit by stone-walling at bends

this is a very cheap expedient, and will protect an area from grazing for about three seasons.

It is also important that the sources of water supply should be multiplied, for the lay-out of the paddocks should be such that each has its own water supply. In arid country this is probably the greatest difficulty, but even if wells or bores are impracticable, much can be done by simple dams. The multiplication of paths and roads on a grazing area is dangerous, for they are all apt to encourage the commencement of undesirable erosion, and it is desirable to divert any paths which follow steep slopes by turning them along the contour of the slope every few yards. These are all measures which should be drummed into the minds of every stock farmer.

To go to the root of the problem however, the formation of torrential run-off should be tackled high up on every ridge, and the policy adopted should be to spread it out before it concentrates into a limited number of channels all with a steep gradient. This can generally be done by a series of banks of stone or sods running along the contours, with openings at intervals, but these openings

must be "staggered," *i.e.* the opening in one bank must not be opposite the next one lower down. Silt will soon collect behind these banks and rows of trees can then be planted thereon. Erosion sluits which have been formed should not be allowed to continue, and the best way of tackling these is to erect at frequent intervals low barriers made of wire netting securely anchored, with a low stone dam at their base; silt will collect behind these checks, the netting will allow the water to escape, but its erosional force will be checked and each year the ravine will silt up more and more, and particularly so if the water is given an alternative road for escape. Even if the sluit has become a definite ravine within deep walls its character can in time be modified by the planting of trees on the alluvial fans on the convex side of the bends and by walls of rough stone on the concave sections. The growth of the vegetation will in time spread across the ravine and check velocity of flow, and if the scour of the flood water can be reduced, the ravine can in time be reclaimed. (See Figs. 1 and 2.)

As regards agricultural land, the problem is exactly the same and most of the recommendations above enumerated will apply, but the preservation of land for food crops warrants more intensive labour, and on hillsides exposed to occasional torrential rainfall terracing is generally the solution; this policy is widespread throughout the limestone regions of Southern Europe, and probably dates back to the Iron Age; the faint traces of linchets on hillsides in Southern England demonstrate the age of this practice.

In these days of mass production, agriculture on these lines may seem puny and ridiculous, and for crops of large bulk such as wheat, maize, and so forth it is unsuitable; but it must not be forgotten that a great proportion of the vineyards of France and Italy are on terraces, the flower crops of the Riviera are also terrace-grown, and much of the peasant production of food stuffs in Southern Europe is grown by this method. The amount of labour expended on the walling of terrace cultivation through the centuries in those lands must exceed that of all the architectural efforts, but it attracts little notice.

In Central and South Africa the native has yet but little realized the importance of terracing; a little is seen here and there, but in many regions if he is to continue to draw sustenance from his habitat it must be encouraged without delay. His general policy up to recent years has been, as was previously explained, one of shifting cultivation, and that is obviously incompatible with any effort to improve a particular plot of land by intensive labour. The forced abandonment of shifting cultivation will further induce natives to learn the value of manure and fertilizers.

Apart from terracing there are of course many other measures in which he must be educated, which will entail an infinity of patience on the part of his teachers, and the willing co-operation of the native himself must be ensured. All this will necessitate close team work between the administrative staff and trained instructors, and the task must not be delayed, for the need is urgent.

It is difficult for those whose homes lie in the fertile green-clad zone of the world to realize the importance to mankind of the conservation of soil cover. It is pre-eminently a geographical question, for one of the most important branches of this science is concerned with the relation of man to his environment. Geology teaches us that denudation is an inevitable process of nature, all land surfaces are being eroded, and as long as there is rain and as long as the

force of gravity persists, so it will continue, but man with his need to obtain sustenance from the soil must control the *tempo* of this inexorable process or he will starve.

As regards Africa it can be stated without hesitation that the two greatest problems are the checking of erosion and control of the tsetse fly; in many parts the former is the more urgent, and as I have remarked they are often connected. The fact that all European Powers in Africa are doing their best to conserve native life, by the introduction of health services and by improvement of social conditions, is accentuating the problem, for, generally speaking, the native population is everywhere steadily increasing.

DISCUSSION

Before the papers the PRESIDENT (Admiral Sir WILLIAM GOODENOUGH) said: If the title of this lecture had been announced only as "Soil Erosion" it is quite possible that even for an afternoon lecture it might have seemed a somewhat dull and very technical subject; but when one reads on the second paper that it is "A Problem in Human Geography" one realizes at once an interest, opened and widened to any extent that those concerned with the progress of the human race can imagine. That is what is at the bottom of the investigations which have been made into soil erosion. There are two papers, one by Mr. Champion, who is unable to be with us, and the second by Mr. Hobley, who will read both.

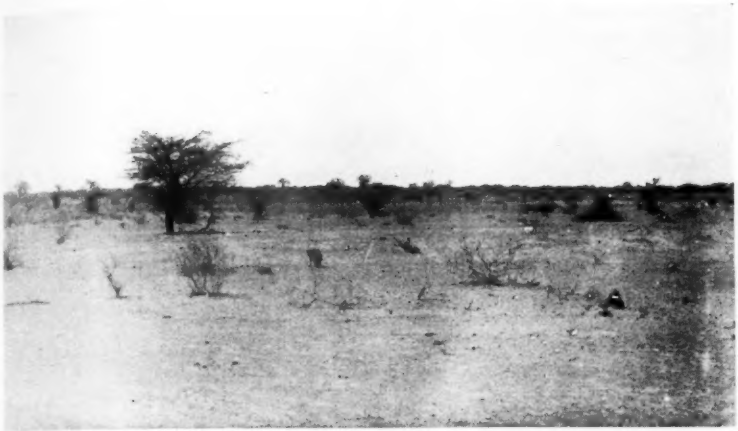
Mr. Hobley then read the papers printed above, and a discussion followed.

The PRESIDENT: Dr. Grantham is a member of the Soil Erosion Commission in Tanganyika Territory. I will ask him to say a few words.

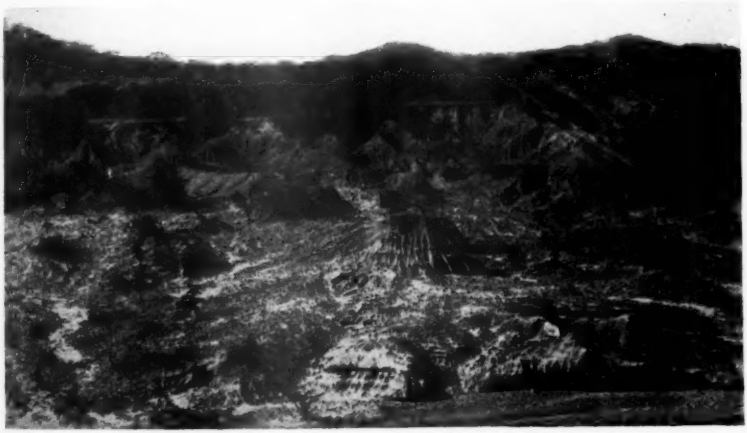
Dr. D. R. GRANTHAM: I thank you for this opportunity of expressing my appreciation of Mr. Hobley's and Mr. Champion's papers, and of adding a few further remarks, because I know this problem is a pressing one. We are attempting along many lines to develop Africa. That cannot be done as fully as it might be, unless the problem of soil erosion is attended to. I should like therefore to emphasize one or two points. One is the time factor: how long these processes have been going on, and how rapidly they are proceeding to-day. Of the damage done you have already heard much. And lastly, I should like to touch on the human causes, that is, those which are capable of control.

Two slides were shown illustrating the time factor; the first, taken seven years ago at Dodoma (Tanganyika), of an area which was then a cornfield; it was under millet, but erosion had already started as shown by bare patches which had lost their soil and could not be cultivated. Three years later (the area was then being converted into a dam) an increase of bare areas was visible and some corrugation; to-day that corrugation has become intense; in fact, a visitor going there for the first time would think it impossible that the area could have been used for cultivation.

Five miles south-west of Dodoma a temporary railway was built during the war; it has now been converted into a road; the small drainage ditches which bordered it are now large enough to accommodate a motor car. The adjacent area, probably cultivated just before the war, is now in an advanced state of "badlands" erosion. Another photograph illustrating the time factor showed a tree, thirty or forty years old, with long spreading roots, which grew underground, but were now lying on the surface, some seven or more inches of soil having been removed. This was in a comparatively flat area, and is remarkable because most of the rapid erosion takes place in hilly country.



Results of overgrazing at Mloda, 33 miles south of Dodoma, Tanganyika Territory



Erosion at Ntanangazi, Iringa district, T.T.

Photographs by permission of Dr. D. R. Grantham

Erosion of open plain near Madibira, T.T.

Path starting erosive gulley, Tanganyika Territory: first stage

Road erosion on the Malangali–Brant road, T.T.: second stage

Photographs by permission of Dr. D. R. Grantham

Sand-flooding below road erosion, T.T.: third stage

When I first visited the Lupa River goldfield, in south-western Tanganyika, I would have described it as barren and uninhabitable, most of its hillsides being covered with loose angular stone; but I was puzzled by finding many old grinding stones scattered about the country. Later Dr. Teale pointed out to me large trees with hacked and gnarled bases amid the forest of smaller ones. These were unmistakable evidence of old cultivation. Actually the whole of the area had been cultivated within the last fifty or sixty years, but it is now desolate. Near Sao (Iringa District, T.T.), of which a slide was shown, at an elevation of about 6000 feet, is much "park-land"; clumps of trees (which represent relics of a once extensive forest) are separated by grass land. Beneath these clumps and in valleys, where more extensive forest fragments remain, can be found up to 3 feet of dark, humic soil, below which is a leached, yellow sub-soil. Where the trees have gone, largely the result of fires, the forest soil has been completely removed and only the sub-soil remains. Humic soil seems more tenacious and resistant to erosion; the removal of cover however aids oxidation and exposed humus is quickly destroyed. This process is aided by the annual (but preventable) grass-fires.

Three kilometres east of Dodoma is a sandy river, crossed by a railway built just before the war. At the time of building the bridge the clearance between the river-bed and rails was 14 feet; now it is only about 3 feet, owing to the silting up of the channel by sand. In the particularly wet season of 1929–30 there were no less than twenty-six wash-aways at this one river crossing. Soil erosion thus engages engineering. The trouble here was due almost entirely to bad methods of native cultivation in the hills above; soil is eroded, the sand being re-deposited and the clay fraction carried away.

The next photograph depicted the clearing of *miombo* forest (savannah type —*brachistegia* and *berlinia*) by natives of a small village; a large area of white ashes showed the new cutting and burning in one year. This happened to be in tsetse-fly country. Therefore cattle were absent, and probably the forest will regenerate. Without the tsetse, after two or three years' crops, the natives would have allowed cattle to graze there, and, even worse, goats to browse, making regeneration impossible.

We are thus confronted with the paradoxes that tsetse-fly is a blessing and water a curse. Where there is water, cattle are concentrated; they eat the grass—seeds, roots and all. With the increase of cattle, the soil cover is progressively removed, and erosion sets in. A ride through south central Tanganyika at the end of the dry season illustrates this contradiction. In parts without water there is bush or tall dry grass, but within a mile or two of a water-hole one sees only desolate bare ground. Education in the rotation of crops and rotation of grazing is urgently needed. Similarly control over grass-fires must be induced, for these also prevent the regeneration of cover.

It is unfortunate that in many places the official attitude has been: "I came; I saw; I considered." And there it stands. In England it is difficult to understand the urgency of this problem; in our damp climate soil does not erode rapidly, but in Africa it is urgent. It is necessary for enlightened opinion in this country to lay emphasis on this pressing problem. Stringent measures must be taken before "I considered" becomes "I conquered."

Mr. SWYNNERTON (Director, Tsetse-fly Research, Tanganyika Territory): I did not know I should be called upon to address the meeting, otherwise I would have come more prepared. I can however call attention to the relation of the tsetse to the problem of soil erosion.

Some ten years ago in the Shinyanga district we were called in to stop the retreat of the population. Approximately thirty thousand people had been driven out

Photographs by permission of Dr. D. R. Grantham

Sand-flooding below road erosion, T.T.: third stage

Road erosion on the Malangali–Brant road, T.T.: second stage

Path starting erosive gulley, Tanganyika Territory: first stage

of the land which they occupied and the country was going back to bush and fly. As the fly advanced into the outlying bush, the people cleared farther back. That allowed the little bushes they were keeping down by constant cutting to grow up. As the people were driven back they became concentrated on a smaller and smaller area. The cattle were driven in with the people and there was very heavy overgrazing, with erosion as a result.

The natives were greatly worried over this progressive loss of their country. We called meetings. The people stated that they were aware that they had only to keep the marginal bush cut down and the fly could not advance. They asked us to organize their resistance. We did so, and the process was reversed. They are now advancing against the fly. But the point is this: in the case of a gradual advance of the kind now proceeding, as you advance you allow more cattle to survive than would have survived had they remained in the more restricted area. That is to say, the cattle population remains too large even for the increased area. The result of that is that the new areas given to the people tend to come under erosion also. When we first set the natives to get back their country they were overjoyed, and we too were only too glad to let them come in with their cattle and see what self-help could do for them. Their cattle came in great numbers. Now, as we give back new country we try to limit the number of cattle allowed on the land reclaimed. This year an Administrative Officer has been attached to our team with a view to controlling the influx of settlers, and especially of their cattle. As long as we can carry on on those lines the areas we reclaim should be safe, but it is absolutely essential, as new country is thrown open, that measures should thus be taken to avoid the possibility of further erosion.

The tsetse-fly has been, in certain directions, one of the greatest benefactors of the country. To-day two-thirds of Tanganyika are under tsetse-fly, and in that two-thirds erosion merely follows the slow natural course. There is no doubt that two-thirds of Tanganyika have been preserved by the fly from erosion and ruination at the hands of the native population. Now however we wish to develop those two-thirds. We wish native population to settle there, but it is our duty, as we clear those two-thirds of tsetse-fly, to see that the native population is allowed in only under regulations which ensure that they do not place too many cattle on the land. Reclamation for development is justified provided that we do our part in guiding the natives to develop the country on proper lines.

One other small point. There is no doubt at all that in cases where cattle are too many for the area, the fundamental remedy is to keep the stock down to numbers which will not ruin the country. On the other hand, we could do more with the cattle than we are doing to-day. Mr. Wakefield, now Acting Director of Agriculture in Tanganyika Territory, with whom I discussed the question before I came to England, suggested that a great deal more use could be made of the cattle than now by teaching the natives to grow feed for them and use the manure from the cattle far more systematically than now for the improvement of the soil. That would lead to permanent cultivation instead of the shifting cultivation which opens area after area to the forces of nature which cause erosion.

Mr. J. B. Laws: I agree with everything that Mr. Swynnerton has said, especially in regard to the necessity of maintaining the fertility of the soil. I think as long as the land is actually under cultivation erosion is comparatively slight. Loss of fertility is the beginning of the process. The natives are now beginning to manure their land in the northern province of Tanganyika, and they are to be encouraged in that and also in the rotation of crops. That seems to me the solution of the problem.

The only other point that occurred to me on reading the papers was that so far as cultivation by Europeans is concerned, for the most part they grow permanent crops and pay great attention to the surface soil. They realize the dangers of erosion, and mulches are used to preserve the surface.

Dr. F. DIXEY: The subject of soil erosion, which is so very important in many parts of Africa, has been so completely covered by the papers that there is very little to add. The question is particularly urgent in countries where a long dry season is followed by a brief season of heavy rains, so that any interference with the vegetational cover of the land leads to accelerated erosion.

I was very interested in Dr. Grantham's remarks on the official attitude towards soil erosion, because I think the administrators of these countries are now beginning to realize the great importance of the problem. Probably it has hitherto been somewhat difficult for those not actually scientifically acquainted with the matter to realize that the land surface does not remain always as one sees it. When dealing with the matter from the scientific point of view it is often possible to see at a glance how rapidly soil erosion is going on, whereas others who have not that advantage may need to live in a country for many years before they appreciate the danger to the same extent. The scientific officers concerned with this question for many years past have had a most discouraging struggle in bringing it to the notice of the authorities, and in ensuring that adequate preventive measures should be taken. Now however the importance of the problem is beginning to be appreciated, and in certain countries inquiries are being made with a view to reclaiming, as far as possible, such land as has been destroyed, and more particularly to arresting the progress of soil erosion in other areas.

The problem has reached such a stage in many parts of Africa that it is now extremely difficult for the natives to find suitable new land on which to settle, and consequently they are faced with the necessity of making the best use of the land still available. The question of settlement often resolves itself into one of providing new sources of water supply; yet that very process leads to the continuation of the danger, in that where water supplies are provided natives and their cattle tend to congregate in limited areas. Thus erosion recommences, and the whole cycle is started afresh.

Consequently, whenever land is being given over to native occupation it is necessary to take steps to prevent it from being spoilt by improper methods of cultivation and by over-grazing. It is essential that the question should be dealt with in a firm and efficient manner. The importance of it has not been realized as much perhaps as the necessity for providing medical and educational facilities for the natives. These have received attention from very early days, whereas the question of preserving the land on which the people can live has been neglected. Side by side with measures for increasing the health and numbers of the native population it is equally necessary to take energetic steps to ensure that the land on which their continued existence depends is adequately protected and handed on for the use of succeeding generations.

The PRESIDENT: It seems to me, first of all, that what we may take from this afternoon's discussion and papers read is great encouragement, and then great admiration for all those officials, white most of them, who teach the coloured people not only of this nation but of all nations; who spend their lives and give, sometimes, their health for the benefit of what are called subject races. I know very well that it might be said by some of those who have been here from time to time during the last three years, "Oh yes, there's the President off on his old horse," but it comes back to this: that the geographer's duty is to do what he can to improve the happiness and the progress of the human race.

I have not spent so very much of my time on the land, but I came across the

problem under discussion when I was Commander-in-Chief of the African Station. The Basutos, a very independent native race which has never been conquered, occupy their own country entirely. They cut down most of their trees for fuel; they have immense herds of cattle and numbers of ponies and horses. They use all droppings of the horses and cattle for fuel. Their country is not being properly fertilized, and a very serious problem arises.

Then there was another problem in Table Bay. Von Reibeck landed on the sand, and where that sand was there is now, I will not say a forest, but a wood of wattle. Gradually the wattle increased the dampness, and the dampness increased the wattle, and, bit by bit, the ground is being reclaimed.

Those two small instances came to my notice during my travels, and I feel immense admiration for the power of man and the courage required for him to confine the forces of Nature for the benefit of human creatures. One could elaborate a theme like that—it has been elaborated in many books—for hours. I am not going to do that this afternoon, but it does give me an opportunity of thanking you, Mr. Hobley, and through you Mr. Champion, very much indeed for having introduced this subject, and also of thanking those who have taken part in what has been a most interesting discussion. It also gives me an opportunity of pointing out that here in this hall is the place where people should come to discuss these great problems of human geography. Such discussions will always be encouraged by the President and Council of the Royal Geographical Society.

THE LEGAL STATUS OF EASTERN GREENLAND

THE judgment of the Permanent Court of International Justice on the legal status of Eastern Greenland was delivered on 5 April 1933. The judgment is a document of the highest importance to Great Britain, with her large arctic and antarctic territories that cannot be closely settled or administered. Happily the English, which is the definitive text, is admirably clear and readable; and no student of political geography should neglect to study it in the convenient publication of the Permanent Court Series A/B, Fasc. 53, by the A. W. Sijthoff Publishing Company of Leyden. The following summary is designed to set out, as nearly as possible in the words of the Court, the points which most nearly concern us as geographers.

By an application filed on 12 July 1931 the Royal Danish Government brought a suit against the Royal Norwegian Government, which had on July 10 proclaimed occupation of certain territories in East Greenland which Denmark contended were subject to the sovereignty of the Danish Crown. The Danish Government asked for judgment that the occupation violated the existing legal situation and was accordingly unlawful and invalid. The Norwegian Government in its Counter-case asked for judgment that Denmark had no sovereignty over Eirik Raudes Land (the name they had given to the East Coast of Greenland between 71° 30′ and 75° 40′) and that Norway had acquired the sovereignty. A large number of documents and maps were filled by each of the parties, and a set has been placed in our Library.

The Court assumed that the area in question is bounded on the east by the sea and on the west by the inland ice [unlike the coasts of Labrador, it did not extend to the watershed]. Greenland was discovered about the year A.D. 900 and colonized a century later by Eric the Red, an Icelander of Norwegian origin [but outlawed]. Two settlements were founded towards the southern end of the west coast, which were first independent, became tributary to Norway in the thirteenth century, but had disappeared before 1500. There is nothing to show that Greenland during this period should not be regarded as a Norwegian possession, and the disappearance of the colonies did not put an end to the King's pretensions to sovereignty. The kingdoms of Norway and Denmark were united under the same Crown between 1380 and 1814.

In 1721 Hans Egede of Bergen formed a Greenland Company which in 1725 was granted for twenty-five years "the whole country of Greenland," but the Company was dissolved, and after an interval a fresh concession was granted to Jacob Severin, with exclusive privileges of trade. This concession expired in 1750, and a new one was granted to the General Trading Company of Copenhagen; but in 1774 the State once more took over the Greenland trade, and in 1776 an Ordinance still in force granted concessions to a privileged Trading Administration, since when the Greenland trade has been a monopoly of the State of Denmark.

By the Treaty of Kiel on 14 January 1814 the King of Denmark was required to cede to Sweden all rights and claims on the kingdom of Norway, excluding Greenland, the Faeroes, and Iceland.

In 1822 Scoresby (a Scot) made the first European landing in the territory

since claimed by Norway. In 1829–30 the Graah Expedition explored the east coast south of Angmagssalik, and at the time of the Norwegian occupation the whole east coast had been explored by Danish expeditions, as well as by non-Danish.

During the nineteenth century the Danish Government made a practice of excluding Greenland from its commercial agreements and acted on the assumption that Danish sovereignty extended to the whole; but private persons in Denmark expressed the fear that the absence of effective occupation exposed the territory to risk from a foreign state. In 1878 the Danish Government set up a Commission which has published much scientific work on Greenland (in the well-known series *Meddelelse om Grönland*).

During the Great War Denmark ceded her West Indian Islands to the United States, and obtained from them on 4 August 1916 a declaration that the United States "would not object to the Danish Government extending their political and economic interests to the whole of Greenland." At the Peace Conference a Committee was constituted to consider claims put forward by different countries to Spitsbergen, and the Danish Government informed the Norwegian that they would raise no objection to Norway's claim to Spitsbergen, and were confident that Danish extension of political and economic interests to the whole of Greenland would not encounter any difficulties on the part of the Norwegian Government. On 22 July 1919 M. Ihlen, the Norwegian Minister for Foreign Affairs, stated verbally to the Danish Minister in Christiania that the Norwegian Government would not make any difficulties in the settlement of the question.

In 1920 the Danish Government obtained formal recognition of its sovereignty over the whole of Greenland from Great Britain, France, Italy, and Japan, and in 1921 approached the Norwegian Government for written confirmation of the verbal declaration of 1919, which the Norwegians were unwilling to give except on condition of non-interference with Norwegian liberty of hunting and fishing. This the Danish Government refused, as it would have reversed their policy of shielding the Eskimo from uncontrolled contact with white races. The Danes then said they would rest content with the Ihlen declaration, and issued the decree of 10 May 1921 that "the whole country is henceforth linked up with Danish colonies and stations under the authority of the Danish Administration of Greenland."

In the following years the Danish Government was willing to satisfy Norwegian desires to hunt and fish on the east coast of Greenland, but on the question of sovereignty refused to admit the Norwegian Government's gradually evolving claim that the uncolonized part was *terra nullius*. After long negotiations a Convention was signed on 9 July 1924 which gave Norwegian ships free access to the coast (except the Angmagssalik district) with right to land, to winter ashore, and erect meteorological and wireless stations; the question of sovereignty being expressly reserved by both sides. By this time the Norwegians had claimed that if they were not *terra nullius* the uncolonized parts must pass under Norwegian sovereignty.

During 1925 the British and French were granted most-favoured-nation treatment, that is, the same rights as Norwegians under this Convention: whereupon Norway informed Great Britain, France, and Denmark that she

had not recognized Danish sovereignty over the whole of Greenland. The question was not raised further until 1930, when Norway conferred police powers on certain of her subjects "for the inspection of the Norwegian hunting stations in Eastern Greenland," and Denmark protested. In the same year Denmark inaugurated a "three year plan" for scientific research between Scoresby Sound and Danmarkshavn; and in 1931 informed the Norwegian Government that she thought it necessary to provide police supervision over all persons in the territory. While the Governments were discussing reference to the Permanent Court of International Justice certain Norwegian hunters hoisted the flag of Norway in Mackenzie Bay and announced they had occupied certain territory in the name of the King of Norway. To a Danish protest the Norwegian Government replied on July 1 that the occupation was an entirely private act, but on July 10 it announced by Royal Resolution the occupation of the country between 71° 30′ and 75° 40′ N., and called it Eirik Raudes Land. On the following day the Danish Government submitted the question to the Permanent Court.

Having thus set out the facts of the dispute the judgment of the Court proceeds to examine the Danish submission that the Norwegian occupation was invalid for two reasons: first that Danish sovereignty over Greenland had existed for a long time and never before been challenged; and second that Norway had recognized Danish sovereignty over Greenland as a whole, and could not later dispute it.

Before considering the first, the Court said that a claim to sovereignty based on continued display of authority involves the intention to act as sovereign, and exercise of such authority. Tribunals have been satisfied with very little exercise, especially over thinly populated or unsettled countries, provided no other State could make a superior claim. The Court held that the rights of the kings of Norway in Greenland in the thirteenth and fourteenth centuries amounted to sovereignty and were not limited to the two settlements. When Hans Egede's colonies were founded in 1721 both elements were present. The prohibition of trading was extended to all places whatever; the burden of proof that the word Greenland has a more restricted meaning, as to the Danish colonies only, lies on Norway, and in the opinion of the Court Norway had not succeeded. Bearing in mind the arctic and inaccessible character of the uncolonized area, the King of Norway and Denmark displayed his authority enough to give him a valid claim to sovereignty over the whole.

Up to 1814 the rights of the King over Greenland were enjoyed as King of Norway; but by the Treaty of Kiel what had been a Norwegian possession remained with the King of Denmark, and Greenland became for the future a Danish possession. In many treaties concluded by Denmark in the following years there is a stipulation that Greenland is excluded, which shows that the other contracting parties were willing to admit Denmark's right to exclude Greenland. The natural meaning of that term is its geographical meaning as shown in the maps; and even if the northern part of Greenland was still unknown, that did not entitle Norway to restrict the name to the colonized area.

There remained the question whether between 1814 and 1915 Denmark's exercise of authority in the uncolonized area was sufficient to give her

sovereignty: Danish Counsel relied chiefly on a concession to an Englishman, Mr. J. W. Taylor, in 1863. The sovereign rights of the King of Denmark entitled him to grant a monopoly and the concessionaires had no doubts as to the validity of the rights conferred. The article providing that the establishments of Mr. Taylor on the east coast of Greenland should be subject to Danish sovereignty and law was inserted, not because they did not otherwise extend so far, but to make sure that these settlements should not be made the basis of a claim of occupation and sovereignty by the King of England. Concessions for telegraphs and legislation on territorial waters, with the absence of any claim to sovereignty by any other Power, support the conclusion that between 1814 and 1915 Denmark had displayed her authority sufficiently to confer a valid title to sovereignty.

There remained the question whether in the applications which Denmark addressed to foreign Governments between 1915 and 1921 Denmark was seeking a recognition of existing sovereignty over the whole of Greenland, or was trying to persuade the Powers to agree to an extension of her sovereignty to territory which did not yet belong to her. In several important documents the expression "extension of sovereignty" if taken by itself would support the latter view. Nevertheless the Court reached the conclusion that the former was the right view. After an exhaustive discussion they decided that there could be no grounds for holding that, by the attitude which the Danish Government adopted, it admitted that it possessed no sovereignty over the uncolonized parts of Greenland, nor for holding that it was stopped from claiming that Denmark possessed an old-established sovereignty over all Greenland.

After 1921 Danish activity on the eastern coast of Greenland considerably increased. Besides exercising the functions of government by regulating shipping, hunting, and fishing, and supporting hunting expeditions, there was a great increase in the number of expeditions engaged in mapping and exploring the country with the authorization and encouragement of the Government; there was a voyage of inspection by a vessel belonging to the State under the command of a naval officer; there was issue of permits to visit the east coast, all showing intention and will to exercise sovereignty. The Court was therefore satisfied that at the critical date, 10 July 1931, of the Norwegian occupation, Denmark possessed a valid title to sovereignty over all Greenland; hence the occupation and consequent steps taken by the Norwegian Government were illegal and invalid.

The Court then proceeded to consider the second proposition, that Norway had given undertakings which recognized Danish sovereignty over all Greenland. It found three cases of such undertaking. By the Treaty of Kiel the King of Denmark was obliged to renounce in favour of the King of Sweden his Kingdom of Norway, excepting Greenland, Iceland, and the Faeroes. In 1819 the Norwegian commissioner at Copenhagen was instructed to claim restitution of these excepted territories, in the course of negotiations, mainly financial, arising out of the treaty; but when Denmark refused, the Foreign Minister for Sweden and Norway authorized the commissioner to withdraw the claim, and to seek other compensation for the loss of Norway's colonies in the Arctic. Moreover, when a little later the Prince Regent of Great Britain

was asked to mediate in the matters still at variance, all claims of Norway in respect of Iceland, Greenland, and the Faeroes were definitely withdrawn. The Court held that in the final convention of 1 September 1819 Norway recognized Danish sovereignty over the whole of Greenland, and consequently could not proceed to the occupation of any part thereof.

Secondly, in various bilateral agreements between Norway and Denmark, and in multilateral agreements to which both Norway and Denmark were contracting parties, Greenland had been described as a Danish colony, or as forming part of Denmark, or Denmark had been allowed to exclude Greenland from the operation of the agreement. Among the latter were the Universal Postal Conventions of 1920, 1924, and 1929 in which Greenland is described as being part of Denmark. In accepting these agreements Norway debarred herself from contesting Danish sovereignty over the whole of Greenland, and consequently from proceeding to occupy any part of it.

Thirdly, there was the case of the Ihlen declaration of 22 July 1919, that the Norwegian Government would not make any difficulties in the settlement of this question. The Court was unable to accept the Danish contention that this was a recognition of existing Danish sovereignty, but it considered it beyond dispute that a reply of this nature is binding upon the country to which the Minister belongs. Norway was therefore under an obligation to refrain from contesting Danish sovereignty over Greenland as a whole, and *a fortiori* to refrain from occupying a part of Greenland.

For these reasons the Court, by twelve votes to two, decided that the declaration of occupation promulgated by the Norwegian Government on 10 July 1931 and any steps taken in this respect by that Government constituted a violation of the existing legal situation and were accordingly unlawful and invalid.

One of the dissenting judges, in a long opinion, rejects the early historical claims, considers that any sovereignty now subsisting dates from the colonization of 1721, and that such sovereignty was limited to the colonized and administered parts of Greenland. The rest was *terra nullius* over which Denmark from 1915 desired to extend its sovereignty. Only Norway objected. But Norway had already, by the Ihlen declaration of 1919, undertaken not to object. The occupation in 1931 was therefore illegal.

The second dissenting judge was one of the two appointed *ad hoc*. In a long opinion he sets out the reasons which to his regret made it impossible for him to sign the judgment which the Court delivered.

This judgment of the Permanent Court of International Justice has a profound importance beyond the limits of the immediate case, not least in showing grounds upon which similar cases which may arise in the future will be decided. To the non-legal mind it might have appeared that the important matters between Denmark and Norway were on the one hand the care of Denmark for the well-being of the Eskimo, and her conviction that the east coast of Greenland must be preserved for the undisturbed use of the expanding Eskimo population: on the other hand the anxiety of Norway to secure a field in which her more adventurous hunters and sealers might earn a good living without

restrictions and under their own flag. There is in the judgment of the Court scarcely a hint of these considerations. The Court kept its attention directed to strict proof of title, and Norway's occupation of the land which they proposed to call by the name of Eric the Red was illegal because Denmark had an indefeasible title to the land deriving from the activities of Eric the Red himself.

THE MOUNT EVEREST EXPEDITION

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THE account in the last *Journal* concluded with information contained in a dispatch dated June 14 when another attempt upon the mountain was just beginning. Between June 4 and 12 Mr. Ruttledge rested his whole party at Base Camp while heavy monsoon snow fell upon Mount Everest. Next day the advance was begun, and on June 16 the whole expedition with the exception of Shebbeare, Wager, and Smijth Windham reassembled at Camp 3 to be ready to occupy the higher camps as soon as the weather should improve. But though the mornings might be fine the snow which fell every evening quite counteracted the clearing effects of wind and evaporation. Avalanches were still frequent, and with the North Col in so dangerous a condition Mr. Ruttledge had no alternative but to take his party back to Base Camp.

When this news was received in England the Committee met to discuss the future of the expedition. They summarized the position briefly as follows: Mr. Ruttledge was anxious to stay near the mountain throughout the monsoon with a reduced party which however would be large enough to make another attempt if the monsoon allowed them. But he had modified his statement that their failure so far had been due solely to climbing difficulties: it was due to climbing difficulties combined with fresh snow and terrible winds, and now that mid-summer was passed and the monsoon had broken there seemed no reason to expect that better conditions would prevail this year. The party had worked under great strain for the last eight weeks and less than half of them were still really fit. Supplies were short, and in any case it would be difficult to re-equip the expedition adequately to make safe a later attempt. It was argued also that it would be unsafe to split the party. It was clear that the expedition had done wonderful work under unfavourable conditions which were unlikely to improve; everything possible had already been attempted, and in view of all these considerations the Committee felt bound to ask Mr. Ruttledge to bring his party home. A wireless message to this effect was dispatched on June 27 and an acknowledgment received on July 1. The party are now on their return march through Tibet, and those who are returning to England will probably sail from Bombay on August 5. J. M. S.

17 *July* 1933

When discussing the chances of the 1933 Mount Everest Expedition with Hugh Ruttledge before his departure, the writer expressed his belief that only two things could cheat them of success—bad weather, or a failure by the porters to carry Camp VI high enough. The latter obstacle, being dependent

on human effort, was successfully negotiated by this most efficient expedition; the former, being beyond human control, has beaten them. For recent dispatches have corrected an erroneous impression, given by the first telegraphic accounts, that the failure to reach the summit was due to sheer climbing difficulties; there now seems little doubt that snow conditions, combined in one case with winds of gale force, were responsible for the defeat of both attempts.

A comparison between the course of this year's expedition and of those of 1922 and 1924 is interesting. Both the 1924 and 1933 expeditions encountered impossible weather practically throughout the month of May, a month which was comparatively fine in 1922, though it must not be forgotten that each of the high climbs in that year happened to coincide with a storm. Whereas however the 1924 expedition subsequently enjoyed a fortnight of perfect weather before the break of the monsoon on June 15, this year, as in 1922, the monsoon broke on the first day or two of June.

Herein lies the great difference between the two years. Instead of the comparatively favourable conditions which marked the climbing above 27,000 feet in 1924, it was carried out this year in the same weather which characterized the whole preceding month. The experience must have been a devastating one; it is certain that the steep and dangerous slabs and "tiles" that guard the final pyramid by whichever route is taken must be impossible when plastered with fresh snow; while to climb, or to descend, as both Smythe and Shipton had to do under such conditions, complicated by terrific winds and a blizzard, must be an ordeal the like of which few men have come through alive and unhurt. Prodigious indeed must be the physical powers that enabled Smythe to survive such an experience with heart unaffected.

In 1924 it was believed that the weather throughout the Himalayas in May was unique in the experience of the last fifty years. If this was really the case it is incredibly unfortunate that the 1933 expedition should have met with similar conditions, in a year too when an early monsoon denied them the chance of retrieving their initial setbacks. Ruttledge and his fine party had achieved the winning position; it is probable that the layout of their camps cannot be bettered, and that above 27,400 feet no alternative site for a high camp, even for one tent, exists. Under such conditions as those of early June 1924 success should have been almost certain had two parties as strong as Wager and Wyn-Harris, Smythe and Shipton been able to go for the top from a Camp VI so situated.

There may be, as there were in 1924, critics of the policy of sending parties of two on the final climb, and these may point to the separation of Smythe and Shipton—which had its parallel in one of the high climbs in 1924—as proof of their contention that no party should consist of less than three on a formidable mountain. There are two answers to this criticism: no expedition yet dispatched to climb Mount Everest has had the resources to establish and maintain at Camp VI the requisite number of successive parties of three for the final climb; and, could it be done, it is doubtful if the summit could ever be reached by a party of three starting from 27,400, for the rate of progress of a roped party is in inverse proportion to its numbers, and time is the essence of this problem.

We have yet to hear, in detail, by what arts and by what expenditure of vital energy the porters were induced to carry to 27,400. The climbers who were thus responsible for establishing Camp VI and the porters themselves who did this record-breaking carry—the "tigers" of 1933—have done a bigger thing than they may realize: this year their efforts were in vain, but there is a curious psychological factor in mountain climbing which dictates that once a thing has been done it can be repeated again and again: *c'est le premier pas qui coûte.* Camp VI at 27,400, if not higher, may be counted on as a permanent feature of any future expedition.

We have much more yet to learn. Does the meteorological department in Simla consider that both the years 1924 and 1933 were quite exceptional from the point of view of weather? What exactly did Wager and Wyn-Harris think of the possibilities of the second step as an alternative to "Norton's route"? Did they try a variation of the latter, crossing the big couloir above its point of junction with the yellow band? What further advances in the progressive raising of the standard of comfort achieved each year are already projected? The possibilities of future success are bound up with such questions hardly less than with that vital one: will the Tibetan Government permit another expedition in the near future?

But we already know one thing: the expedition of 1933 did not fail. Hugh Ruttledge's tireless exertions for over nine months; his fine organization and leadership; the splendid team work and devotion of the whole expedition; and the courage and hardihood of the high climbers, British and Himalayan alike, have done far more than equal the height record of 1924. They have proved the possibility of establishing the key position and of maintaining there the necessary climbers, fit and ready to make the defeat of the mountain a moral certainty, given the reasonably fine weather that they never enjoyed.

E. F. N.

REVIEWS

EUROPE

ON FOOT IN SUSSEX: a loiterer's notebook. By A. A. EVANS. *London: Methuen & Co.* 1933. $7\frac{1}{2} \times 5$ *inches;* xii + 244 *pages; illustrations.* 7*s* 6*d*

In these pages Mr. Evans gives, simply and without a parade of learning, the results of a close acquaintance with the less-known Sussex countryside. His tastes are wide: mingled with descriptions of out-of-the-way churches, such as East Guldeford and Alfriston, are notes on birds and flowers, and incidents of rural life through the centuries. These last, preserving details of a social order now disappearing, are perhaps the most interesting. He writes unpretentiously of places and people in a vein of deep sympathy, so that his book, though not profound and sometimes sentimental, provides some pleasant reading. His photographs are to be warmly commended. G. R. C.

GEOGRAPHICAL REGIONS OF FRANCE. By EMMANUEL DE MARTONNE. Translated from the latest edition by H. C. BRENTNALL. *London: William Heinemann* 1933. $7\frac{1}{2} \times 5$ *inches;* xii + 224 *pages; diagrams and sketch-maps.* 7*s* 6*d*

Professor de Martonne's short sketch, 'Régions géographiques de la France,' first published in 1921, is too well known to require further commendation here. This translation should be welcomed not only by English teachers and students of geography, but by all intelligent visitors to France who wish to profit fully by their travels. Throughout emphasis is laid upon the physical facts which account so largely for the varied aspects of the French landscape of to-day. The translation in places might well run more easily and shows obvious traces of the structure of the original text. The "explanatory index," added to this edition, is a useful feature. The disparity between the English and the French prices for this volume seems to be larger than usual. G. R. C.

THIS IS NORWAY. By FREDA LINGSTROM. *London: Gerald Howe* 1933. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xiv + 152 *pages; illustrations and maps.* 5*s*

This attractive and informative handbook will undoubtedly be much appreciated by those who are anxious to become better acquainted with Norway. It should prove a useful guide to all visiting the country, for apart from the chapters on Physical Geography, Climate, Flora and Fauna, interesting information is included with regard to Norwegian History, Government, Education, Literature and Art, together with details as to Language, Sport, Travel, and Rail and Steamship Routes. A Gazetteer of Towns and Places adds to the value of the book, and the maps and index are adequate. The illustrations include four remarkably effective colour plates by the author. O. M. C.

POLAND. By ROMAN DYBOSKI. (The Modern World. Edited by the Rt. Hon. H. A. L. FISHER.) *London: Ernest Benn* 1933. $8\frac{3}{4} \times 5\frac{1}{2}$ *inches;* 444 *pages; sketch-map.* 21*s*

This is a volume of the 'Modern World' series written by a Pole who is Professor of English literature in the University of Cracow. It states the case for Poland with considerable ability; and a reading of Dyboski's book, together with Plutynski's 'The German Paradox,' also published this year, should serve to acquaint the Englishman interested in foreign affairs with the Polish point of view on a group of "questions" any one of which may at any time confront Europe with an acute crisis.

Of the ten chapters of Dyboski's book four are historical and the other six devoted to a survey of the political, economic, and cultural life of present-day Poland. The first chapter, dealing with "Old Poland," is the least satisfactory, for although it brings out well the historical effects of Poland's age-long quest for outlets on the Baltic and the Black Sea, it is much too allusive for a popular work, and cannot be said to give a clear bird's-eye view of Polish history to the layman. The chapters on contemporary Poland are the best; Chapter VI on Minority Problems is specially important for its detailed treatment of the Ukrainian Question, of which Europe is likely to hear much more in the future than it has in the past. One of the issues connected with it is that of the draining of the Pripet marshes, four million acres in extent; "their utilization for normal agriculture would mean an enormous addition to the wealth of Poland," but this involves the regulation of the Dnieper, which lies entirely in the power of Soviet Russia.

The author dispels the widely prevalent illusion that Poland and the Little Entente form inevitably a single *bloc* of states. The Little Entente consists essentially of the nations which have partitioned Hungary. But Poland has taken nothing from Hungary, and is strongly pro-Hungarian in sentiment, while she has a standing quarrel with Czecho-Slovakia over the Teschen district.

G. F. H.

GOING FOREIGN: a volume of information for those about to cruise abroad in small yachts, with specimen voyages in Holland, Belgium, and France. By CHARLES PEARS. *London: Edward Arnold & Co.* 1933. 9×5½ *inches; 224 pages; illustrations and charts.* 10*s* 6*d*

In this very useful volume Mr. Pears first discusses the characteristics desirable in a 10-tonner and her crew for success in cruising on the European coasts nearest to England. He then describes in full detail two cruises in a yawl with a company of three—the skipper, the mate, and the novice—who will be familiar friends to readers of his former book, 'South Coast Cruising.' The first trip is from Ramsgate to Calais and thence along the French coast to Cherbourg and home across Channel to Newhaven. The north coast of France has some attractions, but its detriments seem to preponderate. Fécamp, for example, has choice amenities: "The author's experience of this port was an iron ladder caked with three inches of fish grease, which had collected to itself such sediment of sewage and floating filth as made a lasting dream for him to conjure with for many nights on end. Warps were so thick with it that they had to be cast off and thrown overboard on leaving, and the boat's topsides had to be cleaned with methylated spirits—the only thing which would move it." One has to go to France for that. The second cruise—to Antwerp and the Dutch ports—is more alluring. From Burnham to Flushing, thence up the Schelde to Antwerp and through the inland channels to many interesting Dutch towns and villages, and so by a different route back to Flushing, with a coastwise passage to Zeebrugge before turning homewards to the Thames Estuary—all this made a delightful voyage.

So far we have been following the adventures of a fictitious ship and crew, whose dialogue is made the vehicle of much information. Mr. Pears concludes with a short and stirring account of an actual cruise of his own made last summer with one companion: Burnham—Dover—Boulogne—Calais—Ostend—Burnham. This cruise makes the best reading in the book, for the final passage of forty-three hours from Ostend to Burnham in very bad weather was a great test of seamanship and endurance.

Any one contemplating a sailing cruise to the regions dealt with will find this volume indispensable, and the descriptions of coast-line will be informative to

non-sailing geographers, for the impression of a coast derived from standpoints on land is totally different from that obtained by approaching it from seaward, especially when navigating one's own boat. It is then that all sorts of features become vital which the shore-going observer will overlook. J. A. W.

YUGOSLAVIA: a New Country and Its People. By GRACE ELLISON. *London: John Lane* 1933. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* xiv + 304 *pages; illustrations and sketch-maps.* 12*s* 6*d*

Miss Grace Ellison had a great opportunity of writing a useful, because needed, book on the united kingdom of the six southern Slav countries. During her visit, when she travelled leisurely throughout Yugoslavia, she was the guest of Prince Paul, and she had visited the various countries as separate entities before the war, and so was in a position to make comparisons between the old régime and the new. She had unusual and enviable facilities for seeing everything she desired to see and she met many interesting people; finally she had an audience with King Alexander. The circumstances in which she travelled probably made frank criticism difficult, but her enthusiasm appears genuine. She wandered over the Julian Alps, through Croatia, across South Serbia; she made her way to Cetinje, and along the Dalmatian coast; she saw Bosnia and Hercegovina, and visited Belgrade. Unfortunately however she has not acquired the art of conveying information about places and people in a straightforward manner; she is far too much concerned with her personal reactions and trivial adventures, and the traveller-egoist must also be an artist in words if he is to avoid being a bore. It is difficult to be interested in the fact that Miss Ellison split a back tooth while having tea with some ladies in Cetinje; one would have liked to have heard more of the ladies. Her description of Dubrovnik is far too cursory; Mostar, that westernmost outpost of Islam, is dismissed in a sentence; she makes not even a passing reference to the mausoleum of Diocletian at Split, so that the irony of mass being celebrated over the resting-place of that persecutor of Christians evidently escaped her. Her writing suffers from gush—intelligent people do not want to be told that "the scenery was marvellous"—and exclamation marks bristle on her pages like a forest in winter: "The United Kingdom of the Southern Slavs! At last! At last!" She met Mestrović, the great Dalmatian sculptor whose aim is to express the Serb spirit in his work. But although she "loved the bust of his mother" she does not even mention that rare and magnificent temple of his at Cavtat, one of the finest things of its kind in Europe. As a serious description of Yugoslavia as it is to-day, this book is quite inadequate; and the reader who goes to it in search of information will put it aside with irritation and disappointment. O. R.

A HANDBOOK TO THE PALACE OF MINOS AT KNOSSOS, with its dependencies. By J. D. S. PENDLEBURY. *London: Macmillan & Co.* 1933. $8\frac{1}{2} \times 5\frac{1}{2}$ *inches;* 64 + xiv *pages; illustrations, plans, and sketch-map.* 4*s*

As curator of the Palace of Cnossus and one of Sir Arthur Evans's principal assistants, Mr. Pendlebury speaks with the highest archaeological authority; but his aim in this small book has been not so much to write an archaeological handbook as to make the various Minoan sites of Cnossus intelligible to the visitor. The main part of the book therefore is an explanatory commentary upon the standard tour of the palace and its dependencies, accompanied by a series of plans and photographs intended partly to assist the tourist but partly also, it seems, for those who cannot themselves visit the site. This part is excellently done, and the author has sensibly disencumbered it of general considerations by prefixing a chapter on the historical development of the palace and site, enabling

him to refer without explanation during the tour to the various rebuildings and alterations. But this first chapter is written somewhat piecemeal: in fact, we are given two accounts, one chronological and one topographical. As a result the first is not easily intelligible without reference to the other—which of course is no great matter in a brief guide; and there is a good deal of duplication in the two accounts, which in so short a work is less venial. At the same time the historical account tends to take the palace as a whole for granted, and to offer merely a chronicle of its erection and alteration. An idea of its general conception, and of the functions of its parts and the activities which it was required to house, can be gathered, if at all, only from incidental remarks. At the end the palace stands reconstructed to our view—no small achievement—but still unexplained. A glossary might have been helpful to the tourist confronted with such terms as orthostate, rhyton, and dromos; and a section or two would help our understanding of the complicated levels: otherwise there is little fault to find with this very convenient guide. D. A. G. H.

ASIA

HUNTER'S MOON. By LEONARD M. H. HANDLEY. *London: Macmillan & Co.* 1933. 9×5½ *inches;* xiv+268 *pages; illustrations and sketch-map.* 15*s*

Those who dislike reading of the slaughter of wild animals will do well to pass this book by, well written though it is; those who are interested in the craft of big-game hunting will find it absorbing. Major Leonard Handley is not one of those lavishly equipped shikaris who expect to collect trophies from the back-veranda of a bungalow; for such as these he has nothing but contempt; he is the true hunter, glorying in the green solitudes of the jungle, content to travel frugally and without European companions, and prepared to work for his game. Into this volume he has packed the knowledge and experience of twenty-two years. Year after year, he tells us, he was lured back to the "cool green recesses of the Central Province forests," and he has hunted through Mysore and the leech-laden jungles of Tenasserim, in Burma and in Siam, always with the aim of leaving roads and arteries of civilization behind. He was chiefly concerned with tiger ("the hunting of which never grows stale"), elephant, and rhino in Southern Tenasserim, whose heavy jungles are never likely to tempt the shikari in quest merely of scalp and horn. One of the most exciting of his experiences was the hunting of the man-eater of Danauli, and once he hunted man—a Siamese elephant-poacher, Tanoy, who shot Mahtir Singh, Major Handley's hunter, and after a desperate flight met his end in the toils of quicksand. There is however much more in this book than the recorded adventure of the chase, for Major Handley has transferred to the printed page not only his jungle lore but his own passionate love of Nature untouched and unadorned, and has illustrated his book with some unusually beautiful photographs. O. R.

ANCIENT MONUMENTS OF KASHMIR. By RAM CHANDRA KAK. *London: The India Society* 1933. 10×7½ *inches;* xvi+172 *pages of text*+lxxvii *plates; illustrations and plans.* 25*s*

Of the varied charms of the scenery of Kashmir, that "garden of eternal spring," as the Emperor Jahangir calls it in his Memoirs, many accounts are available. As regards the archaeological remains however the descriptions of Vigne, Cunningham, Cole, and Growse need revision and amplification in the light of more recent research. The author of this work, himself a Kashmiri, is peculiarly fitted for this task by his training and by the local knowledge and experience acquired as Director of the Archaeological Department of the State for ten years.

After introductory chapters on the country, its history, and the peculiar features of its architecture, Mr. Kak gives a clearly written, up-to-date description of the principal monuments that have survived the ravages of nature, time, and man; and Kashmir, in the course of its history, has suffered grievously from the effects of war and religious bigotry. The book being intended for the use of the ordinary visitor who takes an intelligent interest in the subject of archaeology, the monuments have been dealt with in groups according to their situation, distances and modes of travel being noted. For the archaeological student the greatest interest will attach to the description of the remains at Harwan, some $1\frac{1}{2}$ miles from Srinagar, first revealed by Mr. Kak's excavations some years ago, which show peculiar types of structure, called by him "pebble" and "diaper pebble" styles, as well as a temple courtyard paved with large moulded brick tiles in great variety of shape and pattern, features, so far as we know, not found elsewhere in India. The patterns of these tiles and the technique of their moulding and incision seem to call for further study by some one with a working knowledge of the potter's craft.

The illustrations are admirably produced. For further detail of architectural features the student should consult the excellent photographs in Lieut. Cole's monograph on 'The Ancient Monuments of Kashmir,' published in 1869. The absence of an index and, more particularly, of a map showing the positions of the monuments described is to be regretted. C. E. A. W. O.

THE JESUITS AND THE GREAT MOGUL. By Sir EDWARD MACLAGAN. *London: Burnes Oates and Washbourne* 1932. $9 \times 5\frac{1}{2}$ *inches;* xxii+434 *pages; illustrations and sketch-map.* 17*s* 6*d*

Sir Edward Maclagan has written a work of massive learning on the history of the Jesuit Missions to the Mogul empire, or Mogor, as it was called by the Portuguese in contradistinction to "India," the independent regions of South India. The first mission was sent in 1580 at the invitation of Akbar, and missionary activity was continued until the Papal suppression of the Society of Jesus in 1773; Father Wendel, the last survivor of the Mogor Mission, died in 1803, the year which also saw the capture of Delhi by the English and the extinction of Mogul sovereignty.

The missionary policy of the Jesuits in Mogor was similar to that pursued by them in China and Japan; in all three fields effort was concentrated on the monarch and his court in the hope that the conversion of the ruler would render easy the conversion of his subjects. In no one of the three realms, however, did they succeed in converting a ruling monarch, though they were often treated with marked favour, mainly on account of their secular accomplishments. In India Christianity had the advantage that it was confronted, not by a unified religious culture, but by two conflicting religions at a deadlock with each other, and it seems likely that Akbar at one time contemplated the adoption of Christianity, as "the only way to compose the communal problem was to impose on all the people a third religion from outside." But he finally attempted such a solution with a religion of his own making.

The Mogor Mission was closely connected with early exploration beyond the Himalayas, and of this side of its work the author gives a very interesting account. Aquaviva wrote from Fatehpur in 1582: "We have discovered a new nation of heathen called Bottan (Tibetans) which is beyond Lahore towards the River Indus, a nation very well inclined and given to pious works. They are white men, and Mohammedans do not live among them." In 1603 a member of the Mogor Mission was sent out to locate Cathay, the land famed from Marco Polo and not certainly known in the sixteenth century to be identical with China; this

was Benedict de Goes, whose great journey from India to Kansu by Kabul, Yarkand and Hami is one of the landmarks in the history of travel. In 1626 two Fathers penetrated to Shigatse, and thirty-five years later Grueber and D'Orville, two Jesuits of Peking, came thence to Agra by way of Koko-nor and Lhasa.

G. F. H.

THREE KINGDOMS OF INDO-CHINA. By HAROLD J. COOLIDGE and THEODORE ROOSEVELT. *New York: Thomas Y. Crowell Company* 1933. 9 × 5½ *inches; 332 pages; illustrations and sketch-map.* $3.00

Financed by the late William V. Kelly and organized by Theodore and Kermit Roosevelt, the Kelly-Roosevelts Expedition of the Field Museum of Chicago set out at the end of 1928 to study and make collections of bird, mammal, and reptile life in South-East Asia. The expedition was in two sections, the Roosevelt brothers specializing in large mammals and operating, first in western Szechwan and later in Cochin-China, while a party of four worked the northern territories of French Indo-China.

Of this book the greater part is an account of the Lao-country party, written by its leader Harold J. Coolidge, Jr.; three chapters being added by Theodore Roosevelt on the Cochin-China section. Preparations for the expedition were in hand for a year before it started, and the French Government gave it every possible facility, wherefore Mr. Coolidge found consignments of necessaries awaiting him at various points of his journey, and the local officials, French and native alike, everywhere ready to entertain and assist him. The route of his party lay from Hanoi up the Red River to Lao-Kai; thence across country westwards, *via* Lai-Chow, to the Nam Hu; down that river to its juncture with the Mekong at Luang Prabang, and 1000 miles down the Mekong, *via* Vien Tiane, to Savannaket; finally some 200 miles eastward to Hué. This section was in the field about six months. The book, or at least the first part of it, is a tale of adventure in lands afar, and no mere record of technical matters. Sumptuous entertainments by Governors, bivouacs in remote outposts with hard-bitten French officers, campings in primitive villages with hospitable jungle-folk, long rides through steaming forests on diminutive ponies, wild rushes down fierce rapids in the flimsiest of canoes; such are the incidents set down by the young writer with a humorous philosophy making light of trials, discomforts, and dangers frequently encountered. But enough is said to show that the conversion of the surrounding fauna into "specimens" proceeded incessantly side by side with these exploits. Unfortunately the party suffered much from malaria and dysentery, the results of having started work too late in the season by just about two months. One of the members died from malaria, a tragedy that cast a gloom over the last days of the expedition.

The chapters by Mr. Roosevelt describe spirited encounters with buffalo, gaur, banting, and, finally, elephant; at first on the Lagna river, a tributary of the Donai, and later on higher ground at a place not to be identified under the vague name "Flat Rock." There is much skinning of large animals in pouring rain and muddy surroundings, and everybody has malaria. Exciting work, doubtless, but exacting.

Mr. Coolidge adds an appendix of twenty-four pages on the origin and customs of the hill-tribes encountered by the expedition; debatable ground over which, with the assistance of certain French experts, he flits with entertaining lightness. The book is well illustrated with photographs and is eminently readable, and while its educative value may be less than the publishers seem to think, its interest for the general reader will, perhaps, be more. The scientific results of the expedition have proved of much importance. A few errors of fact occur. Thus: the *ken* is a

wind, not a stringed instrument (p. 189); no Mahout sits "perched on the elephant's head" (p. 191); "The Thai Tribe" seems a strange way of alluding to the great Thai race (p. 256); and the denizen of the human hair (when present) is not a flea (p. 284). The "splendours" of the pinchbeck Royalty of Luang Prabang are overdone. There is an insufficient index and a more than insufficient map.

W. A. G.

AFRICA

MEN AND CREATURES IN UGANDA. By Sir JOHN BLAND-SUTTON. *London: Hutchinson & Co.* 1933. 9×5½ *inches; 252 pages; illustrations.* 12*s* 6*d*

The author in this pleasing and well-illustrated book touches on a great variety of subjects. Though not going far off the road, yet he notices many things in ordinary places which other travellers carelessly pass over. He has much to tell of the Masai and Kikuyu, their modes of dress, weapons, and ornaments. Their ear-borings and hair-dressings have specially interested him, as indeed might be expected in a distinguished surgeon. On animals he has a large variety of information. The different antelopes are illustrated and briefly described, as are lions, zebras, crocodiles, and others. The more striking of the Uganda birds are mentioned; even the insects are not forgotten, since there is a short sketch of the habits of white ants. The chief point about the book is its pleasing variety. It does not go deeply into any subject, nor would the author pretend that it put forward any novel research; but it gives a bird's-eye picture of Uganda life which it makes particularly clear by means of many excellent wood-cuts. R. W. G. H.

AUSTRALASIA AND PACIFIC

GOLD-DUST AND ASHES: the romantic story of the New Guinea Goldfields. By ION L. IDRIESS. *Sydney (Australia): Angus and Robertson* 1933. 7½×4½ *inches;* x+286 *pages; illustrations and sketch-maps.* 6*s*

The quest for gold has moved men of adventurous spirit to almost incredible feats. In this book the story is told of the development by Australian mining pioneers of an area of alluvial deposits in the eastern section of the Mandated Territory of New Guinea. The difficulties were immense. The area lies in an extremely wild forest-clad mountain region within a few degrees of the Equator, inhabited by primitive and at time hostile savages; and the only means of transport available for some years over the 70 miles between it and the coast was by convoys of human porters following the rude native tracks through the jungle and along the high narrow ridges. There a century of technical progress in gold-getting has been compressed into less than ten years; in 1923 a shrewd prospector "living *kanaka*" was working single-handed with simple panning methods: in 1932 the district was served by a fleet of aeroplanes, powerful dredging machinery had been transported by air over the roadless mountains, hydro-electric power had been developed, and mining settlements had sprung up. The price of these enterprises under conditions trying for white men has been a heavy toll of life—a number of the leading figures among the pioneers, having grown wealthy, died prematurely.

The narrative is built up round the personalities of the pioneers in prospecting and air transport, who are presented in an easy style enlivened by Australian and native idiom. Though the reader is taken through a kaleidoscopic succession of incidents with corresponding changes of scene, this restlessness does not mar the interest of the story. The photographic illustrations are clear and helpful, and one would like to have more of them. E. W. S.

PHYSICAL AND BIOLOGICAL GEOGRAPHY

DEUTSCHE ATLANTISCHE EXPEDITION AUF DEM FORschungs- und Vermessungsschiff *Meteor*, 1925–1927. Wissenschaftliche Ergebnisse. Edited by ALBERT DEFANT. Band VII. Erster Teil. Die Gezeiten und inneren Gezeitenwellen des Atlantischen Ozeans. Ergebnisse der Strom- und Serienmessungen auf den Ankerstationen des *Meteor*. By ALBERT DEFANT. *Berlin: Walter de Gruyter & Co.* 1932. $11\frac{1}{2} \times 8\frac{1}{2}$ *inches*; xii+318 *pages; maps and diagrams*

The chief problem of the *Meteor* Expedition was the investigation of the general circulation of the South Atlantic Ocean by observations of the vertical distribution of temperature, salinity, and other oceanographic elements at over three hundred stations. But at ten of these stations the subsidiary problems of the time-variations of these elements and of the direct determination of currents were studied, and it is these subsidiary problems which form the subject of the volume under review. At these ten stations the ship was anchored in depths extending to 5000 metres and for periods of about two days; frequent observations of current, temperature, salinity, and oxygen-content were made at depths extending to 3000 metres, but mostly in the upper 250 metres. The volume contains the record of all these observations, their analysis, and a discussion of the oceanographical questions which they elucidate. Though similar work has been done previously, notably by O. Pettersson, F. Nansen, and Helland-Hansen, the wealth of material collected and the extent of the region covered by the *Meteor* Expedition make the present study one of capital importance.

The time-variations are found to be chiefly tidal in character, though at one station oscillations with periods of 5·6 and 2·8 hours are found in all the elements. The harmonic constituents of current have amplitudes of the order of 10 cm./sec.; those of temperature sometimes exceed 1° C., and those of salinity sometimes exceed 0·1 per thousand, but they are usually much less. At each station there is an approximately homogeneous layer extending from the surface down to depths of 50 or 100 metres. The tidal variations of temperature and salinity reach their maximum amplitudes near the lower boundary of this layer, and it is concluded that they are due to tidal variations of its thickness. These variations of thickness involve the rise and fall of water relative to the surface, and it is this rise and fall which constitutes the phenomenon of "internal tides." The amplitudes of these internal tides are calculated to be of the order of 5 metres. The constants of tidal current at the anchor stations are augmented by those due to Pillsbury and Helland-Hansen, and the phases of the whole are found to follow a geographical distribution which is remarkably simple.

Besides the reduction of observations the book contains a good deal of theory, both on the main distribution of the ordinary tides over the Atlantic and on the dynamical nature of internal tides. The author makes the hypothesis that the semidiurnal tides along the central line of the Atlantic are unaffected by the rotation of the Earth and by the transverse components of the disturbing forces due to the moon and sun. On this hypothesis he calculates the distribution of tides along the central line in such a way as to get the maximum agreement with observations from the Atlantic islands. He then finds satisfactory agreement between the corresponding currents and the observations from the anchor stations, and concludes that his hypothesis is a first approximation to the truth.

On the dynamics of internal tides, Defant examines a number of type-problems, and concludes that the only possible cause of the phenomenon lies in the variations of the ordinary tidal current with depth. J. P.

ECONOMIC AND HISTORICAL GEOGRAPHY

BYZANTINE CIVILIZATION. By STEVEN RUNCIMAN. *London: Edward Arnold & Co.* 1933. 9×5½ *inches;* 320 *pages.* 16*s*

Mr. Runciman, who has already given us two books on Byzantine history, 'The Emperor Romanus Lecapenus and his Reign,' in 1929, and then in 1930, 'A History of the first Bulgarian Empire,' now presents us with this "general picture of the civilization of the Roman Empire during the period when its capital was Constantinople," that is, from May in the year A.D. 330, when the Emperor Constantine the Great dedicated his new capital city of "New Rome which is Constantinople" down to the same month in 1453 when the last Constantine fell in the heroic defence of the walls of the city against the Ottoman Turks under their great sultan Mahomet the Conqueror. In accordance with the plan of the book an introductory historical outline is followed by chapters on the constitution, on religion, on the army, on commerce, on education, on literature, on art, and so on, and the book ends with a chapter entitled "Byzantium and the neighbouring World." Mr. Runciman thus challenges comparison with some of Diehl's works, and perhaps even more closely with Hesseling's 'Essai sur la civilisation byzantine,' and his is the first short book, so far as we know, in English to cover this ground. For the student too the book has the very great advantage that the author gives in footnotes his more important references; an index further distinguishes his work from that of his French rivals.

In a book covering so wide a field the chapters are necessarily of somewhat unequal merit, and Mr. Runciman is right in pointing out that in only three hundred pages not much can be made of the intricacies of Byzantine Law and of the controversies in which the study of Byzantine Art is at present involved. The present reviewer found the chapter on "Town and Country Life" particularly interesting: here the author has made excellent use of the details of life to be gathered from a study of the lives of saints, details such as are hardly to be found in historians of greater dignity. Everywhere use has been made, and good use, of the best modern authorities: for trade he has naturally gone to Heyd's 'Histoire du Commerce du Levant,' and the chapter on "Education and Learning" has profited from Mrs. Buckler's 'Anna Comnena.' To cover so much ground in so few pages is no light task, but there are no unpleasant marks of compression, and the result is throughout extremely readable. If a fuller treatment had been possible, Mr. Runciman could have given us much that he may well have felt sorry to omit. For example, the liking of the Byzantines for theological discussion is well known, and on p. 215 we are told how Cinnamus and a certain bishop were terribly surprised and shocked when the Emperor Andronicus I told them to talk of something else, as he found religion so boring. The story is from Nicetas, and the details are that the emperor was not inclined to follow the general line of society in acquiescence in the dogmas of the church, and when his companions were discoursing on the text, "My Father is greater than I," he not only rebuked them, but grew angry and said that he would throw them into the river if they did not stop talking about God. Long before this, too, Gregory of Nyssa had complained of the theologizing vulgar who infested the city: if a man asked the price of bread, the baker, harping on the same text as that which puzzled Cinnamus and the bishop, would tell him that the Father was greater than the Son, and a money-changer, asked for the current rates, would philosophize about the Begotten and the Unbegotten.

Unfortunately too many slips and inaccuracies have found their way into the book. On p. 235: Anaximander was not a philosopher of the fourth, but of the sixth century B.C. The odd name of the nun *Hypomene* (p. 214) is

really *Hypomone*=Patience. A proper construing of the passage from Nicetas quoted on p. 218 would have substituted *statue* for the almost meaningless *pillar*. These mistakes do not stand alone.

But it is fair to end the review of so useful a book with praise rather than with blame. The remarks on the weakness of Mithraism in comparison with Christianity, that it was very much a religion for men only, and that it also excluded Greek philosophy, which had so nourishing an influence on Christian thought, show clear insight. A religion for military "hearties" was not likely to conquer the world. On p. 220 he very justly sums up Byzantine virtues and vices. They were not so much cruel as fickle and lacking in personal loyalty; they were too cynical to be charitable: "it was not human life but human nature that they rated too low." Nor will Mr. Runciman tolerate the too often expressed view that the sultans were in any real sense successors to the Byzantine emperors; he very truly says (p. 294) that "from Byzantine they borrowed very little but the capital."

We do not know any book in English which gives in so agreeable a form and in so small a space such a clear account of the main features of the civilization of Byzantium. R. M. D.

ENGLAND'S QUEST OF EASTERN TRADE. By Sir WILLIAM FOSTER. ("The Pioneer Histories." Edited by V. T. HARLOW and J. A. WILLIAMSON.) *London: A. and C. Black* 1933. 9×5½ *inches;* xiv+354 *pages; maps.* 15*s*

The joint editors of the Pioneer Histories, Mr. Harlow and Dr. Williamson, have been fortunate in securing, as contributors to the first few volumes of the series, writers each of whom is a leading authority in his chosen field. Professor Newton, Professor Prestage, and Sir William Foster can not only be trusted to set out lucidly and in their true perspective the very tangled series of events which shaped the course of European expansion; they can be relied on also to provide out of their rich knowledge of contemporary documents and personalities just those details that are illuminating and new. While the broad subject dealt with is of profound importance as providing the historical background to the complex world relations of to-day, the volumes will not only appeal to the historian and the student of affairs, but will find readers also among those who, to quote the editors' own words, "dwell most on individual character, courage, and ingenuity"; for "movements are made by men," and by men worth knowing. 'England's Quest of Eastern Trade' exemplifies the editors' sound judgment in planning the series, for it brings together for the first time within the compass of a single volume a number of topics which have hitherto been treated as though unrelated. The search for the North-West Passage, and for the North-East Passage, the great circumnavigations, the journeys into Persia, the establishment of the Levant Company, had all as their objective the opening up of trade relations with the East, which was finally achieved when the East India Company came into being. As Sir William Foster points out, it is often mistakenly asserted that the purchase of cheap pepper and spices was foremost in the adventurers' mind; actually they considered it urgent to find new "vents" for English woollens, especially broadcloth, which explains why the supposedly colder Cathay was as frequently mentioned in the various projects as the tropical Moluccas. To the fact that as the world's middlemen they had such a variety of goods in their warehouses, may perhaps be traced the superior success of the Dutch. There was not, as events proved, the remotest chance of winning the Chinese or the Japanese over from their traditional silks and cottons to the wearing of English broadcloth, especially as, even in Europe, the cloth sold for as much as £12 the piece of 32 yards. Even the cheaper serges and baizes fetched 2*s*. to 3*s*. a yard in Spain and Italy, and could

hardly have been sold for less than twice as much in the East. Sir William touches very lightly on the fact that the operations of the East India Company aroused very severe criticisms at home, and not least for the drain of bullion necessitated by the reluctance of Asiatic merchants to buy English goods. He appears, too, to share the East India Company's view that Sir William Courteen's Association, with its schemes for planting colonists in the Indian Ocean, and for covering a very much wider field of operations, represented merely a troublesome and unfair encroachment on the Company's privileges and monopolies. Nevertheless, if the Association had been better supported and better led (Courteen himself died almost at the outset), it is probable that it would not have been left to the Dutch to make the first systematic reconnaissance of Australia. The story, as it is here related, of the Company's attitude to the China trade, is indicative of a general timidity and conservatism that must have been very hard for the men actually out in the East to bear, for they saw the Hollanders seizing opportunities which orders from home obliged themselves to miss.

Nevertheless, the very fact that there are so many problems which the reader would like to discuss with the author, shows how alive and fascinating is this narrative of the events of three centuries ago. Throughout runs the thread of the rivalry between the English and the Dutch. Now the Dutch East Indies of to-day comprise nearly three-quarters of a million square miles of territory, with something approaching 60 million inhabitants; the external trade is of the order of a hundred millions sterling, and through their possession of these islands the Dutch play an important role in the world situation in respect of sugar, oil, and rubber. Francis Drake came home in 1580, having secured a trade pact with the King of Ternate, but the island is now one of the Dutch Moluccas, for that treaty was never implemented. How all these things came about no one would find it easy to say, but the key to the situation lies in the events described in 'England's Quest of Eastern Trade.' E. G. R. T.

PIONEER SETTLEMENT: co-operative studies by twenty-six authors. American Geographical Society. Special Publication No. 14. Edited by W. L. G. JOERG. *New York* 1932. 10×6½ *inches;* vi+474 *pages; diagrams and maps.* $5.00

This work continues Bowman's 'Pioneer Fringe' with a series of local studies, mainly by workers on the spot, of pioneer belts in various parts of the world. It includes articles on Alaska, the Prairie Provinces of Canada (including the Peace River district), the northern Great Plains of the United States, the Eastern Andes Valleys, the Matto Grosso Plateau of Brazil, the Gran Chaco, Patagonia, the Union of South Africa, the two Rhodesias, French North Africa, the fringes of the U.S.S.R. territories, Manchuria and Mongolia, Australia, Tasmania, and New Zealand. The conception of such a work, and the organization of the collaboration on what is quite literally a world-wide scale, speaks volumes for the calibre of the responsible officials of the American Geographical Society, mainly, it would seem, Dr. Isaiah Bowman.

The problems of pioneer settlement are not limited to geographical problems, and the list of contributors includes historians, economists, sociologists, and politicians, besides geographers. The regions, also, that are studied are of great diversity in their natural conditions and in the types and numbers of settlers they are attracting, and it is consequently inevitable that differences should exist in the kind and amount of material available to the investigators, in their points of view, and in the criteria they adopt for the delimitation of their pioneer areas. Such differences do not necessarily constitute a defect, and may indeed be a positive virtue, but it does seem that the differences that in fact appear are

so great as in some instances to prohibit a comparative view by the reader. The Canadian team, for instance, for some purposes include the whole of the Prairie Provinces as a pioneer area, while Gordon Wood for Tasmania and Condliffe for New Zealand include in each case the whole country in treating the problems of land settlement. Griffith Taylor, on the other hand, dealing with Australia, includes only those areas having a population density of not more than one per square mile (and most of his pioneer area therefore has been occupied for over sixty years), while Wellington for the Union of South Africa confines himself to the belt where land for new settlement is still available. One cannot help regretting that a stricter definition of pioneer areas was not adopted. It might be reasonably argued that the one essential distinguishing mark of all pioneer areas, difficult to demonstrate statistically, but impossible to miss in the field, lies in a certain quality of human life arising out of the newness of the settlement. "Newness" is of course a relative term, liable to great variation from one area to another in terms of years, but capable of assessment against adjacent established settlements. Such a limitation would, we think, have brought the contents of the book more completely into harmony with the title. That however is the only major criticism that suggests itself: the omission by the Canadians of any reference to the pioneering on the Clay Belts of the Canadian Shield is an important detail, but only a detail.

It would perhaps be invidious to distinguish among essays each of which is excellent, but a geographer may be pardoned for pointing out that only the geographer authors have mapped their pioneer areas for the benefit of the reader. Many of the essays are not, and are not intended to be, geographical, but each of them is a contribution to the literature of the area that forms very valuable "collateral" to the serious geographer. Nor are the collection of the material, and the publication of authoritative judgments, the only merits of the work: constant indication is given of the lines of investigation still to be pursued to make the studies adequate. Finally, maps and illustrations are numerous and good, and the bibliographies are excellent—in short, the book is a credit to the great society that sponsored it. R. O. B.

GENERAL

A MODERN WORLD GEOGRAPHY, for Middle and Upper Forms. By E. W. SHANAHAN. *London: Methuen & Co.* 1933. $7\frac{1}{2} \times 5$ *inches;* xii+574 *pages; diagrams and maps.* 5*s*

This text-book of Geography is a distinct success. The author claims no novel treatment of his subject, and has chosen the logical method of describing the natural setting of a country, its climate, plant, and animal life, and development by man. In carrying out his scheme, he has succeeded in keeping a sense of balance throughout most of his book.

The first seven chapters deal with general aspects of world Geography; and one can recommend Chapter I as a good elementary summary of the structure and arrangement of the Earth's surface and its representation on maps. Chapter II deals with relief, drainage, and erosion, and is well illustrated by diagrams. There are some controversial statements about ice-erosion (*e.g.* p. 24: "These [ice] sheets cut very deep valleys in the mountains . . ."). The necessity for condensation of fact and elimination of controversial matters has led in some cases to undue compression and even to misleading statements, as on p. 26, where the following is to be found: "Rivers crossing plains swing from side to side of their valleys gradually raising the level of the whole surface." Chapter III summarizes climate, and is not altogether satisfactory. It is a mistake (on p. 31) to state that

"Japan [is] a country whose climate resembles the temperate European type." One can picture the reproduction of this later on in innumerable examination answers by Matriculation candidates. This is further complicated by a far more accurate and quite different description of the climate of Japan on the following page. The explanation of Desert Climates is misleading owing to the author's conviction that pupils of sixteen years cannot understand the position of the high and low pressure belts. While it is true that it is unnecessary for Matriculation candidates to discuss the deeper causes of the distribution of air pressure, there is no reason why they should not associate the great desert areas with belts of calms and descending compressed air rather than with the Trade Winds *only*, as is suggested in this book. The diagram on p. 42 ignores (no doubt deliberately) the belts of calms which separate the wind zones of the world. Other small errors appear in this and other chapters, which can easily be corrected in the next edition. The rest of the general summary is good, especially the chapter on Human Geography.

Section II deals with Europe and the British Isles; but while the treatment of the former is good, that of the latter is disappointing, especially the chapter on Scotland and Ireland, which begins with the odd statement, "Scotland and Ireland, besides being of nearly the same area, resemble each other broadly in structure and relief." Do they? The rest of the chapter is devoted to the points in which they differ. This illustrates a tendency that the author reveals to find resemblances between the most unlikely places. His passion for comparison leads him to make some curious statements, *e.g.* on p. 111, "the recently established Irish Free State corresponds to the old country of Portugal." See also the suggested comparison between Rotterdam, Antwerp, and London (p. 185), and between Kiev and Moscow (p. 242).

In general, the sections on Asia, Africa, America, Australia, and New Zealand (which follow in this order) are interesting, accurate, and up to date. It is a pity that maps of such important river basins as those of the Rhine and the Nile should be so incomplete. Occasional lapses occur (*e.g.* "Magellan . . . the bold Spanish navigator," p. 309). The book, which runs to over 500 pages (with over 150 maps and diagrams), finishes with questions and an excellent chapter on "Hints for Learners," for which every teacher of Geography in Upper Forms may be grateful.

On the whole the book is one to be thoroughly recommended. So much of it is excellent that one can only wish that the author had not deliberately curtailed considerations of the economic development of the lands and that he had succeeded better in his treatment of the British Isles. A. B.

FAR BUGLES: a story of soldiering, adventure, and travel. By Lieut.-Col. COLIN HARDING. *London: Simpkin Marshall, Ltd.* 1933. 9×5½ *inches;* iv+230 *pages; illustrations and sketch-maps.* 7*s* 6*d*

Colonel Harding can look back upon much noteworthy work in Africa between the years 1894 and 1922. His unpretentious collection of reminiscences reveal the early history of Rhodesia as viewed by an active participant. He had varied experiences in command of native police forces during critical years in Mashonaland and Barotseland, when he displayed courage, tact, and a sense of obligation towards the native population. His later service in Africa was performed on the Gold Coast, where for some years he was a Provincial Commissioner. In the interval, he had distinguished himself during the war in command of a Service battalion of the Royal Warwicks. His book, though sometimes distressingly facetious and sententious, is worth reading, if only for its record of the equanimity and good humour with which the author met rough and smooth alike. G. R. C.

THE MONTHLY RECORD

AN INDUSTRIAL STUDY OF BARCELONA

We have received a 70-page pamphlet by Herr Julius O. Reichenheim, 'Die Wirtschaftliche Bedeutung von Barcelona,' a publication of the Berlin University *Institut für Meereskunde* (New Series: B, no. 8, March 1933). Herr Reichenheim's is a seminar study, and remarkable as such for the exceedingly well-balanced picture which it presents of Barcelona's place in Spain, past and present. We say advisedly "place in Spain," in spite of the title, for the fact which emerges most clearly from this monograph is that Barcelona, whatever it may have been in the Middle Ages, has to-day no standing of any kind in the economic world apart from its place inside the high tariff walls of Spain. The industries of Catalonia, controlled by Barcelona, depend on the internal Spanish market, and their state of health varies inversely with their control of that market, the cotton industry with a virtual monopoly being in the poorest health, and the "heavy" industries, with one-half of the market still to conquer, in the best. But none are able to compete to any important extent in the external market, not even in the Spanish-American, in which a sentimental preference might have been won if the psychological moment had not been neglected. The foreign trade of the port of Barcelona is accordingly lop-sided, and the export trade (at present one-tenth, and one-fourteenth, of that of Genoa and Marseille, respectively) is not likely to be materially increased by the extension to the city of the standard gauge on the trans-Pyrenean railway.

From the available evidence it appears therefore to be a reasonable conclusion that there is, after all, no up-to-date Catalonia with a vigorous life of its own, straining at the leash with the dead-weight of Castille behind, but a slightly antiquated Catalonia living on the rest of the Peninsula, with which its financial interests are moreover inextricably intertwined. If this Catalonia, with one-tenth of the population of the whole country, pays one-third of the taxes, the case is not, in essence, one of differential direct taxation, but of indirect taxation of very widely distributed incidence. The author mentions the taxes in a footnote, but omits this obvious comment. His study is not, in fact, quite so objective as he intends it to be. The pure objectivities of physical geography are notably absent, except for some elementary considerations of topography, called (not very happily) structure; and there is a latent assumption throughout that the Catalan is really superior in activity and enterprise to his fellow-Spaniards; this is to look at the Peninsula through Catalan spectacles.

The author's use of statistics however is admirably sane and unbiassed; though a healthy distrust of mere juggling with figures cannot excuse the errors of arithmetic on p. 63. Secondary authorities, too, are all very well in a work of this kind, but the anonymous authority responsible for the statement that the British Government prohibited, under pain of death or penal servitude, the exportation of certain textile machinery until the mid-nineteenth century, seems to be of a still lower order.

DISTRIBUTION OF POPULATION IN BOHEMIA

The extent to which the rural population of Bohemia is being attracted to the towns is strikingly illustrated by Dr. J. Pohl in a study—"Dépopulation de la Campagne en Bohême durant la période de 1850 à 1930" (Praha, 1932). The study is written in Czech, but, being accompanied by notes, a précis in French, and excellent maps, is likely to be of use to students not conversant with that language. The two chief maps, on the scale of 1/400,000, show the increase or

decrease of the population during two periods, 1850–1880, and 1880–1921, the unit being the cadastral commune. The first shows the population, mainly agricultural, growing normally, and distributed very symmetrically over the country. The second indicates areas of rapid growth around four centres, with a steady decline of rural population, especially in the southern, higher, half. Along the north-west boundary, around Falkenau and Carlsbad (Karlovy Vary), and from Chomůtov, Most, Teplice-Šanov, to Děčín, there is marked agglomeration, but not so strong as in Praha and the surrounding region, eastwards along the upper Elbe. Similar concentration around Pilsen (Plzeň) is also apparent. All these areas, and many smaller, increased over 200 per cent. during the period 1880–1921. Preliminary figures also show that a large area around Praha has continued to increase (by over 15 per cent.) in the years 1921 to 1930. This may be compared with the increase in the London census area of 9·7 per cent. in the same period, and that of the Coventry "conurbation," 14·3 per cent.

This growth has been accomplished despite a heavy fall in the birth-rates of the towns. The construction of railways and rapid industrialization account for the flow, though the richer agricultural areas tend to stabilize population, as do areas of small farms near industrial centres, and areas where cottage industries can be profitably established. Depopulation is most marked in Southern and Eastern Bohemia. The drift of population is producing valuable results from a national point of view, as it leads to intermingling of Czech and German elements.

HYDROLOGY OF LAKE TANGANYIKA

A useful summary of existing knowledge of the hydrology of Lake Tanganyika has been put together by Mr. C. Gillman, Chief Engineer of the Tanganyika Railways, whose previous contributions to the geography of East Central Africa have been noticed in the *Journal* from time to time. It forms Bulletin No. 5 of the Geological Survey Department of the Territory (Dar es Salaam, 1933). The paper deals in turn with the main features of the Tanganyika basin (including under that term the whole catchment area of the lake), the characteristics of the water, depth and varying levels of the lake, the régime of inflow and outflow; and though the data on some of these subjects are not so complete as for some other African lakes, Mr. Gillman has made the best use of such as exist and reaches various conclusions of interest, differing in some respects from those of former writers. The lake lies in the narrow strip of ground which separates sub-arid from sub-humid Africa, and its basin shows a wide range of climatic factors. The mean annual rainfall on the lake surface is reckoned at about 900 mm., that on the tributary basins varying from 700 to 1100, while the mean annual evaporation may be tentatively placed at 1350 mm. As to the depth of the lake, one is surprised to read that the current idea has long been that the greatest depth was about 300 m., for far greater values were reported by the early explorers. Mr. Gillman refers to the soundings by Dr. Stappers and Captain Jacobs in 1912–13 (recorded at the time in the *Journal*) which gave depths up to 1430 m., but is not aware of any first-hand report on the work of the former. (Our notice in 1914, vol. 43, p. 442, was based on a summary given by Dr. Stappers in the *Revue Congolaise*.) Anyhow the depth is great enough to place the lowest part of the lake bottom at something like 1000 m. below sea-level—roughly comparable with the corresponding figure for Lake Barkal and the Caspian.

Careful attention is given to the fluctuations of lake-level and the associated history of the Lukuga outlet. Whilst so good an authority as Theeuws held that the old régime of the lake was changed once for all by the *débâcle* of about 1875, Mr. Gillman lays stress on the climatic variations of such a region, and regards the *débâcle* as probably a recurrent phenomenon. Following the event of 1875

the level sank till 1894, when the lowest stage was recorded, the level then again rising till 1900. Since the establishment of regular observations in 1909 there have been maxima in 1909, 1917, and 1927, and minima in 1911, 1923, and 1929, showing a marked relation to the sunspot cycle. The greatest absolute range has been about 1·6 m., while the greatest annual fluctuation has been 0·83 m. While some writers have thought the régime of the lake (the balance between gains and losses) to depend almost entirely on the precipitation on and evaporation from the lake-surface, Mr. Gillman finds that the mean inflow from tributary basins is by no means negligible. He places the total at 17 milliard cbm., while the figures for precipitation on the surface, and outflow, are 29 and 3 milliards respectively, the last being deduced from the estimated evaporation of 43 milliards. The possibility of long-period changes of level, which might have serious effects on man's activities on the lake-shores, must not be lost sight of. The paper ends with a comparison with other Central African lakes and with an attempt at correlation of levels with solar activity. It is found that Tanganyika has to a large extent followed the variations of the other lakes, but that there are irregularities in all, which should be a warning against premature generalizations.

ANCIENT AQUEDUCT NEAR MATRUH, EGYPT

The discovery of an ancient subterranean aqueduct west of Matruh, which must have once provided that settlement with drinking-water (the source of such a supply having hitherto been a puzzle) was made two years ago, and is the subject of a paper by Mr. G. F. Walpole, published by the Survey of Egypt (Paper No. 42, 1932). The find is not only of antiquarian interest, but the systematic excavation and survey of the aqueduct, and of the tract in which it occurs, have shown that it may possibly be utilized to provide a much-needed water-supply for the Matruh area. The tract in question consists of a belt of remarkably white dunes running parallel to the coast and overlying a bed of porous oolitic limestone. From the high limestone plateau to the south four wadis descend across a rocky sterile area with steep slopes, which permit a quick run-off after rain. The dunes and underlying rock block its passage to the sea, so that pools are formed, the seepage from which saturates the oolitic limestone and provides a reservoir of excellent sweet water overlying a stratum of brackish water which descends from the interior. The clearing operations were impeded by the overlying sand which penetrated by means of the numerous manholes or shafts sunk along the course of the aqueduct by the original makers: these had to be closed by caps of cement. The survey showed that the total length, including side galleries, reached 854 metres. The tunnel had been driven through the solid limestone, permitting a symmetrical cross-section throughout, the sides curving gracefully from the base to a flat roof 30 cm. wide. Its course was erratic, involving the occupation of ninety stations to complete the underground survey. The paper, which is well illustrated by maps, plans, and photographs, enters into a careful discussion of the probable supply provided by the occasional rainfall, and the precautions to be taken during pumping operations to avoid sucking-up the saline stratum from below. Proposals are also made for an extension to the south-west with a view to increasing the area of supply, and for the construction of a storage reservoir. It is suggested that this aqueduct may have been one of the sources of water-supply available to Julius Caesar when besieged by the Alexandrines in 48 B.C.

REGULATION OF LAKE OKEECHOBEE, FLORIDA

With an area of 700 to 800 square miles, but a maximum depth of only about 15 feet, Lake Okeechobee is, next to Michigan, the largest body of fresh water entirely within the United States. It lies only slightly above sea-level, and has

hitherto discharged mainly into the swampy area of the Everglades, to the south. It will be remembered that great loss of life and destruction of property was caused on the shores of this lake by the hurricanes of 1926 and 1928, the storm-waves being piled up at one point to a height of 29 feet in the latter year. The *Monthly Weather Review* of the U.S. Department of Agriculture, in its issue for January 1933, contains a paper by Mr. A. J. Mitchell, describing projects now on foot for better regulation of the lake with a view to obviating such disasters in the future. Even before 1926 a good deal had been done by the State of Florida in the way of building levees and digging drainage canals, but economic development rather than protection of life had been their special object, and for the latter they proved insufficient in the face of the unprecedented violence of the storms in question. The new projects have been set on foot by the State and Federal Governments jointly, and an extensive series of levees will be built both on the north and south shores, those on the south extending for 63 miles in the arc of a circle, with a crest elevation of 34 feet above mean low water in the Gulf. For the discharge of the flood-water there is the St. Lucie canal in the east, with a capacity of 5000 cubic feet per second, and the Caloosahatchee Canal on the west, carrying half that volume. With the cutting of further channels, including one across the lake itself, an important through waterway will be provided, crossing the Florida peninsula from the Gulf to the Atlantic.

NEW ASCENT OF MOUNT McKINLEY

The May number of the *Alpine Journal* contains a brief account by Mr. A. D. Lindley of a successful ascent of both peaks of this mountain made by himself and three companions in 1932. Previously the only complete ascent had been that of Archdeacon Stuck nineteen years before. The north-east ridge by which the Archdeacon made the ascent had been badly shattered by the Katmai earthquake in 1912, which added greatly to the difficulties, but it was thought that the snowfall of nineteen years would have sufficiently smoothed the ridge to justify the attempt by a party whose previous experience had been rather of winter skiing than high mountaineering. The north-east route, which has the advantage of avoiding the long ascent of the Muldrow glacier from its foot, was therefore once more chosen. After sending back the dog-teams and establishing an intermediate camp at 12,000 feet the party took a week to move the packs to the top of the ridge at 15,000, where they found the registering thermometer left by Archdeacon Stuck, the needle of which had sunk below the limit of its range, 95° below zero F. A final base was formed at 17,000 feet, whence the south (higher) and north peaks were climbed in succession, with two nights' rest between. From the summit of the former fine distant views were obtained, the descent being made by a slightly different route. One of the party, Pearson, had two somewhat narrow escapes, but came through with little damage from a downward slide of 500 feet and a fall of 40 feet into a crevasse. Another party on the mountain at the same time—consisting of Mr. Allen Carpe, known for his previous ascents in this region, and one companion—was not so fortunate, both losing their lives through a disaster the scene of which was passed by Mr. Lindley and his companions during their descent.

GRAF ZEPPELIN'S ARCTIC VOYAGE, 1931

In the *Journal* for December 1931, a brief summary was given of the geographical and photogrammetric results from the Arctic cruise of the *Graf Zeppelin* in the summer of 1931. More details of the photographic survey were given in the following November. It is only necessary therefore to call attention here to a recently issued *Ergänzungsheft* (No. 216) to *Petermanns Mitteilungen*,

which contains the complete scientific results of that flight. It is prefaced by a detailed synopsis of flying in the Arctic by Professor Samoilovich, who also considers the requirements for successful expeditions. He admits that airships are handicapped at present by inability to land without outside assistance, and advocates the establishment of bases in the Arctic. The volume also contains reports upon the meteorological and magnetic work, and on the geomorphological and geological evidence drawn from the air photographs, of which a large selection are published; and a bibliography of the Taimir peninsula and North Land. In addition, there are maps of portions of North Land on the scale of 1/400,000 and 1/25,000.

ORIGIN OF GREENLAND ICE CAP

In the *Geological Magazine* for April 1933, Mr. L. R. Wager, who was geologist of the British Arctic Air Route Expedition, produces a map showing the contours of the Greenland Ice Cap based on data collected by all expeditions up to the end of 1931, and discusses its age and origin. The higher parts of the ice-sheet are adjacent to the higher mountains on the east coast, and there are two culminations, a northern and a southern, the former exceeding and the latter not quite attaining 3000 metres (about 10,000 feet). The height of the cap is not, at its present stage, controlled by the form of the underlying surface, and one of the controlling factors is apparently the coastal mountains which, where high, impede the outflow of the ice, causing it to pile up and form the higher parts of the cap.

It is represented that since the inland ice of Greenland has persisted longer than the Quaternary ice-sheets it is reasonable to suppose that it may have likewise begun earlier. Where the ice-cap is high it probably overlies an unmodified elevated peneplain which has been preserved by a continuous covering of ice since its original uplift. In the Forel area this peneplain is fringed by a mature valley system believed to be due to prolonged glacial erosion dating likewise from the time of original uplift. In Greenland there are no Tertiary sediments yet known which are newer than the Lower Eocene, and various geological evidence points to the main uplift of Greenland having taken place in Miocene times. It is accordingly concluded that the Greenland Ice Cap is contemporaneous with the main uplift in the Miocene.

The foregoing geological indications concerning the origin of the ice-sheet fit in well with climatological principles. It is unlikely that the ice-cap could have originated without uplift, and if the ice were permitted a freer outflow so as to uncover the land-surface in the centre, which according to Wegener's results is less than 500 metres above sea-level, it is doubtful whether present climatic conditions would re-establish the cap.

Hence it seems that the vast ice-sheet in Greenland, like the smaller one in Iceland (*Geogr. J.*, vol. 80, p. 460), persists because the ice is thick enough to raise its height over extensive areas well above the snow-line.

STORM WAVES AND TROPICAL CYCLONES

In the *Monthly Weather Review* for February 1933 Mr. Isaac M. Cline points out that the heavy seas developed by tropical cyclones are not only their most destructive agency, causing enormous loss of life through drowning, but are at the same time far more timely and effective indications of the approach of cyclones to hurricane-ridden coasts than the movements of the barometer. On this point he writes from personal experience on the Texas coast as an official forecaster at New Orleans. Having found that the storm waves only developed in the right-hand front quadrant of a cyclone, he conducted an investigation to discover why, and found that the reason must be sought in the right-hand rear quadrant. In the latter the winds have a direction which is nearly the same as

that in which the cyclone is travelling, so that, with a fetch of many hundreds of miles, they develop waves and swells of much greater size and length than those developed in other portions where the direction of the wind is constantly changing. The seas which build up on the coast in the right front of the cyclone thus result from the transfer of water to shore by the winds in the right rear of the system.

The waves and swells which range from 20 to 50 feet in height travel with high speed, and passing out of the cyclonic area reach the coast far in advance of the storm. With the storm waves and swells are associated powerful currents which run coastwise from right to left across the right-hand front of a cyclone, and do much damage to buoys, jetties, and other works. The currents developed by a tropical cyclone which is approaching the coast run across the right-front quadrant of the storm in towards the coast and contribute to the formation of the destructive seas. In cyclones travelling coastwise currents of considerable force are developed more than 125 miles to the right of the path of the centre of the storm and run nearly parallel to the coast.

The success of this method of predicting the course and intensity of storms suggests a wider application. It is a familiar fact round the English coast that the first hint of coming bad weather is sometimes given by a rising swell long before there is anything in the local weather to account for it.

CORRESPONDENCE

SUBMARINE TROUGHS OF THE MEDITERRANEAN

During the last two years a series of interesting articles by the late Professor J. W. Gregory has appeared in this *Journal* concerning submarine "troughs" in Cabot Strait,[1] off Cyprus Island,[2] and off the coast of Morocco.[3] He has attributed each of these to diastrophism rather than to erosional processes. On the other hand, I have suggested that the Cabot Strait trough is erosional, having been shaped by glaciers coming out of the Gulf of St. Lawrence,[4] and that troughs of this nature are found only along glaciated coasts.[5] Questioning this assumption, Professor Gregory compared the "trough" off Morocco with the deep in the Strait of Gibraltar, and stated that the characters of each "are those which Mr. Shepard assigns to glacial troughs." He continues, "The similarity of these troughs off glaciated and unglaciated coasts is an argument in favour of their tectonic origin."

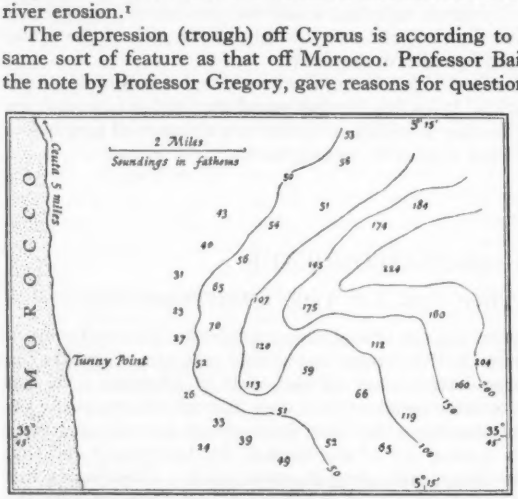
From a study of the charts of the Strait of Gibraltar and of the depression off the north-east coast of Morocco it is difficult to find any grounds for comparison between the two. Soundings are scarce in both cases, but the general character is determinable. The Strait of Gibraltar has steep sides and a broad base justifying the use of the term "trough." It also contains very flat basin depressions and rather sharp rises. This is not unlike the fault valleys of western United States, and gives good ground for Professor Gregory's claim of tectonic origin. On the

[1] "The Earthquake of the Newfoundland Banks," *Geogr. J.*, vol. 77, pp. 129–134.
[2] "Submarine Trough off the Coast of Cyprus," *Geogr. J.*, vol. 78, pp. 357–361.
[3] "Submarine Trough near the Straits of Gibraltar," *Geogr. J.*, vol. 79, pp. 219–220.
[4] "Saint Lawrence (Cabot Strait) Submarine Trough," *Bull. Geol. Soc. America*, vol. 42, pp. 853–864.
[5] "Glacial Troughs of the Continental Shelves," *Journ. Geol.*, vol. 39, p. 347.

contrary, the depression indicated off the north-east coast of Morocco (see figure) appears to be the head of a V-shaped valley which evidently slopes outward down into the deep Mediterranean. It apparently lacks both the trough shape and undulating longitudinal profile which are characteristic of what I have called glacial troughs. Furthermore, this depression does not extend out from a fjord-like indentation in the land as do the glacial troughs of the continental shelves. This last objection as well as the excessive depth apply to a comparison of the Strait of Gibraltar to the glacial troughs.

The depression off Morocco is similar in appearance to a valley having more soundings which comes out of the Bay of Gibraltar. Both are found off small rivers and at least the latter has the shape of a river-cut valley. Such features are common off the various coasts of the world, and where soundings are numerous they have characteristics which make it difficult to attribute them to anything but river erosion.[1]

The depression (trough) off Cyprus is according to Professor Gregory the same sort of feature as that off Morocco. Professor Bailey Willis, referring to the note by Professor Gregory, gave reasons for questioning the tectonic origin of the depression.[2] He attempted to explain the feature as due to submarine currents. Such an explanation may be applicable to this case, but the evidence available in other submarine valleys suggests a lack of strong currents. The sediment in the bottom of these valleys consists commonly of muds and oozes, and certain observations show a static condition of the bottom water (*Geogr. Review*, vol. 23, pp. 80–82). Professor Willis objected to the idea that such valleys as that off Cyprus could be due to river erosion on the grounds that there is insufficient evidence in Cyprus as elsewhere of uplift of the lands during the Pleistocene. The uplifts however may have been much more remote since there is evidence that the valleys where filled with sediment may have been reopened from time to time by landslides (*Geogr. Review*, vol. 23, pp. 83–88).



There are many other submarine valleys in the Mediterranean, notably along the coasts of Palestine, southern Italy, and the Gulf of Genoa. Unfortunately, all of these have few soundings. A fine opportunity exists here for a yacht owner to contribute to scientific knowledge by determining the true nature of these valleys. In a yacht equipped for sonic soundings it would be a matter of only a few hours to make a fairly detailed survey of a valley of the Mediterranean type.

FRANCIS P. SHEPARD

University of Illinois, Urbana, Illinois, U.S.A.

[1] F. P. Shepard, "Submarine Valleys," *Geogr. Review*, vol. 23, 1933, pp. 77–89.

[2] Bailey Willis, "A Submarine Trough off the Coast of Cyprus," *Geogr. J.*, vol. 79, pp. 349–351.

MEETINGS: SESSION 1932–1933

Annual General Meeting, 19 June 1933. The President, Admiral Sir William Goodenough, in the Chair.

The Hon Secretary (Mr. W. L. Sclater) read the Minutes of the meeting held on 20 June 1932, which were confirmed and signed by the President.

In making the presentations the PRESIDENT said: Mr. Wordie, His Majesty has approved of the award of the Founder's Medal to you for your work in Polar regions. We bear in mind that you were a member of Sir Ernest Shackleton's expedition in the *Endurance*. Not only did you carry out admirable scientific work on that occasion but we know that you were one of those who were of the greatest assistance to Sir Ernest Shackleton in keeping up the morale of the whole company. Your success in organizing and leading three expeditions to North-East Greenland in the years 1923, 1926, and 1929 was most marked. In each of those expeditions the work was thoroughly planned and executed, and resulted in extensive surveys of great accuracy in the regions of Scoresby Sound, and included the first ascent of Petermann Peak. Besides all this we recognize that you have given a most enthusiastic support and brilliant example in training a number of young Cambridge men as Polar explorers.

Mr. J. M. WORDIE: Mr. President, I thank you for the award of the Founder's Medal. The grant of one of the Society's medals is the greatest incentive that a traveller and geographer can have, and I value it as deeply as former recipients have in the past. I have always worked with others, and I should like to add that I regard my companions as all-important in the work which has been accomplished, both in Greenland and elsewhere.

The PRESIDENT: His Majesty the King, on the recommendation of the Council of the Royal Geographical Society, has been pleased to award to you, Professor von Drygalski, the Patron's Medal which bears His Majesty's effigy. In the North we remember that you investigated the glaciers of West Greenland between Jakobshavn and Upernivik in the years 1892 and 1893, and the results of these expeditions were published in two volumes which contained valuable information on the theory of glacier movement and the physics of the great Ice Cap. In the South not only did you in years gone by lead a German Antarctic expedition in the *Gauss*, where you made a successful wintering in the Antarctic pack-ice, but with immense skill and perseverance you have completed the compilation and publication of all the research which you were able to make. These, Sir, we know were completed under conditions of extreme difficulty. We remember how you collaborated with Sir John Murray and Sir Clements Markham—names well known and dear to this Society. These volumes—twenty in number—together with two volumes of maps form a permanent memorial to your enthusiasm and tenacity, and it was a privilege to have them reviewed in our *Journal* for December 1932.

Professor ERICH VON DRYGALSKI: Mr. President, I am deeply sensible of the great honour His Majesty has done me in bestowing upon me the Patron's Medal. In my Polar researches I have frequently received encouragement and stimulus from the Royal Geographical Society, especially from one of its Presidents, Sir Clements Markham, and from Dr. Mill, and I recall with pleasure my harmonious co-operation with the expeditions of Scott and Shackleton. When Captain Scott set out on his last journey, from which, unhappily, he did not return, he wrote to me that he wished I could go with him, so that we might work together on the ice. Since my return my work has been directed towards the publication of the scientific results of my journeys, and this has now been com-

pleted. In this too I have worked in close collaboration with British explorers and have made use of the copious results of their researches. It is a special pleasure to me that to-day, when Mr. Wordie's researches in the Antarctic have received their due acknowledgment, my own have also been recognized by the Royal Geographical Society. I thank you once more for the honour you have done me.

The PRESIDENT: The Murchison Grant has been awarded to you, Dr. Noel Humphreys, for your geographical work in the Ruwenzori during the last few years. You have climbed most of the principal peaks and your careful record has added very greatly to our knowledge of the range both north and south of the central massif. It is of great interest to see how you have made a proper use of photography from the air in combination with ground control. It is also an encouragement to see how much excellent work you have done at a modest expenditure. We realize that your interests have extended to collecting plants and other matters closely allied to the activities we profess in this Society.

Dr. NOEL HUMPHREYS: Mr. President, Ladies and Gentlemen: Thank you very much for this most generous award. I should like to say how much I appreciate the help and sympathy extended by the Royal Geographical Society to those especially who are making but a beginning in exploration. I have reason to appreciate the system: Mr. Reeves taught me surveying; this Society lent me £100 worth of instruments; I had all the interest of the expeditions; and when I return you give me an award. Mr. President, Ladies and Gentlemen, again I thank you.

The PRESIDENT: To you, Miss Stark, is awarded the Back Grant. Those enterprising journeys which you have taken in Luristan have been recorded from time to time in the *Journal*. We recognize that you travel alone with no great regard for your own safety, and without troubling officials too much on that account. We have profited greatly by your literary talent and the attention you have paid to getting an accurate transcript of the names along your routes, contributing to the correctness of our maps. Although you may not have completely solved the problems of the famous Luristan bronzes you have, at any rate, found one of the sources, and we hope that you will continue to prosecute your researches.

Miss FREYA STARK: Mr. President, Ladies and Gentlemen: It is very difficult for me to thank you adequately for this great honour. I feel I have not done very much to deserve it, but no greater encouragement could be bestowed than this Grant. I should like to thank you, Sir, not only for this award but for all the kindness and sympathy which was shown me when I began my journeys. I am sure many have felt as I did, that when one is still a little doubtful and rather discouraged, sometimes, by one's friends, it is most encouraging to receive the sympathy and understanding of the Society. I thank you very much.

The PRESIDENT: The Cuthbert Peek Grant is awarded to you, Dr. Leakey, for your researches in East Africa. It would take a very long time to deal with them fully for they cover a wide range. Climatic changes and their effects on geographical history have been investigated with great thoroughness and courage. These have caused great interest and indeed controversy among students of prehistory and proto-history, and have contributed greatly to our knowledge of the early history of the routes in East Africa. The Cuthbert Peek Grant carries with it the hope that its recipient will continue his work, and in your case it is hardly necessary to say that we know your work will be continued.

Dr. L. S. B. LEAKEY: Mr. President, Ladies and Gentlemen: It is difficult to know how to express my thanks to you, because one hardly expects to have one's climatological work recognized by a Society such as yours. And yet both I, and

those who worked with me, feel exceedingly grateful for the way in which this Society has given its support to what I may call palaeogeography. The work has been done by a whole expedition, not by any one member. On behalf of all I thank you very much for the recognition of that work. We shall certainly hope to continue to contribute to the study of geography. I thank you very much indeed for your encouragement, and the financial help you have given so generously in the past.

The PRESIDENT: The Gill Memorial has been awarded to Khan Sahib Afraz Gul Khan, and I would be grateful, High Commissioner, if you would receive this award on his behalf and transmit it to him. It is an award indeed well earned. Afraz Gul Khan has served with such travellers of various nations as Sir Aurel Stein, Mr. and Mrs. Visser, Dr. de Terra, Colonel Blacker, General Mallison, and Colonel, now Professor, Mason. Skill, resourcefulness, devotion, and unselfishness have marked his career throughout. Professor Mason says that he considers Afraz Khan has done as much for the detailed geography of Central Asia as Pandit Nain Singh did in the early days of pioneer exploration. It would take too long to give a description of all his work as a draughtsman, surveyor, and assistant in archaeology. He first joined the Khyber Rifles in 1907. Persia, the North-West Frontier, the Muztagh Karakoram Glaciers, and the Shaksgam have all seen him, both in peace and war. I hope, Sir, that you will convey to the proper quarter the enthusiasm with which this award was made.

The HIGH COMMISSIONER FOR INDIA: Mr. President: It has been a very great pleasure to me to come here this afternoon and to receive from your hands the award which the Council of your Society has made to Khan Sahib Afraz Gul Khan of the Survey of India. I shall see that it is duly transmitted to H.E. the Governor of the North-West Frontier Province, with the request that it may be presented in Durbar to Khan Sahib Afraz Gul Khan. I feel proud that your Society has, in this way, honoured a fellow-countryman and a fellow-servant of the Government of India. I thank you on his behalf and also on behalf of his colleagues in the Survey of India and his fellow-countrymen at large.

The President then delivered his Anniversary Address, which is printed on p. 97.

The visitors having withdrawn, the PRESIDENT appointed Dr. L. J. Spencer and Mr. Owen Rutter to act as Scrutineers of the Ballot for the President and Council for the ensuing year.

The PRESIDENT, in submitting the Annual Report of the Council, said:

Ladies and Gentlemen: A full account of the Society's finances is given in paragraph 8, and I do not propose to read it unless it is required by this meeting. The circumstances under which we were able to clear the Society of debt will be the subject of the special meeting of which proper notice has been given and I will not waste your time by repetition. The Building Fund is described at some length in paragraph 8a. That and what I have just referred to are interwoven. I would emphasize the desirability of all Fellows doing what they can to bring support to the Society by inducing their friends to become Fellows. It is perhaps unnecessary for me to say that the interest of the Fellows is as always foremost in the minds of the President and Council. Are there any questions anybody would like to ask prior to the adoption of the report?

Mr. Burgess expressed his appreciation of the Report, and hoped that the Council would be able to provide funds for the improvement of the *Geographical Journal*.

Mr. J. M. Wordie then moved the adoption of the Annual Report of the Council and Admiral Sir Cyril Fuller seconded the motion, which the President put to the Meeting, and declared the Report unanimously adopted.

Dr. SPENCER reported that as a result of the Ballot all the Candidates proposed by the Council had been unanimously elected by the Meeting (see List, p. iii).

Sir Percy Cox then entered the Hall.

The PRESIDENT: Sir Percy Cox has just come in. In your name I should like to convey to him not only the warm congratulations of all on his election as President at the end of my time from November, but also to congratulate the Society on having the prospect of being presided over by one who is a proved administrator, a man of great human sympathy, under whose leadership the Society will have, I am sure, great prosperity and progress.

The proceedings then terminated.

THE ANNIVERSARY DINNER

The Anniversary Dinner of the Society was held at the Connaught Rooms on Monday 19 June 1933.

The President and the Hon. Lady Goodenough received the company, which included, among the Guests of the Society: The Viscount and Viscountess Bridgeman, Admiral of the Fleet Sir Osmond and Lady Brock, Admiral Sir Ernle and Lady Chatfield, The Dean of Westminster and Mrs. Foxley Norris, General Sir Walter and Lady Braithwaite, The Master of the Drapers' Company and Lady Macassey, The Astronomer Royal and Mrs. Spencer Jones, Lieut.-Colonel and Mrs. Vanier, Mr. and Mrs. J. M. Wordie, Professor Dr. Erich von Drygalski, Captain Riiser-Larsen, Dr. Noel Humphreys, Miss Freya Stark, and Dr. L. S. B. Leakey.

After the loyal toasts had been honoured, The VISCOUNT BRIDGEMAN, proposing the toast of the Royal Geographical Society, said: I esteem it a very great honour indeed to be asked to propose the toast of the Royal Geographical Society, coupled with the name of its President. It is also a great pleasure to me because the health and success of the Royal Geographical Society is, in my opinion, the greatest hope we have for making good what I consider one of the great deficiencies of education in England during my lifetime. I do not know whether anybody will disagree with me when I say that geography has never had its proper place in the education of the young, or even in the education of the middle-aged or old in this country. As I came into this room, I saw an Eton master who taught me when I was a boy—that may seem impossible—and in spite of his presence I am prepared to say that when I was a boy at school geography did not hold the place it should amongst the branches of education, though probably better attention is being paid to it to-day.

When I had the privilege of being First Lord I used to attend some of the interviews with those who wished to get into Dartmouth with a view to joining the Navy, and I well remember that in one of the tests use was made of a map of the world which was very nicely painted but contained no names. Boys were brought to the map and asked a few elementary questions, and I must confess that I was amazed at the little trouble that appeared to have been taken with the education of those boys before they came up to the Board of the Admiralty. As soon as they entered the Navy they, of course, began to learn geography and continued to do so for the rest of their lives. While I hope the teaching of geography is more thorough than it used to be, I am bound to say I can see very little improvement upon the practice of the past. In fact, I seem to have been better taught in a private school than were those boys who came before the Board.

Then I have had some experience of political life, and I have to admit that those whom I meet there are not all exceedingly well educated in that particular

branch of learning. I can recall the story of a member of the House of Commons, an eloquent orator who became subsequently an Under-Secretary, who, when in opposition, made an impassioned appeal to the Government of the day to send a squadron of H.M. Fleet to the Caspian Sea! Yesterday I had the privilege of seeing the sixty-six delegates of the States represented at the Economic Conference, and I could not help hoping that each was well versed in the geography of the other sixty-five States. If so, we can look forward to most happy results from the Conference.

When I use the word "geography" I do not mean something that deals with the population of a town and its various industries, but something which includes the life and characteristics of the people who live in various places. I do not think it can be seriously disputed that geography does not yet hold its proper place in learning. History, to my mind, unaccompanied by geography, is quite incomplete. Many are spoken of at the close of their lives as those who have made history. A man who makes history should make geography also. At any rate, the making of geography is, in my opinion, just as important as the making of history.

It is obvious that travel is the only way of acquiring complete knowledge of geography and of getting over some of our insular prejudices by obtaining first-hand knowledge of what public men or those dealing with Dominion affairs ought to know. Of course, not everybody has the opportunity of travelling, but those who are able to do so obviously gain great advantage. When I was young I began to take an interest in the Empire by reading certain books on the subject, but I think only those who have the opportunity of going and seeing things for themselves really become thoroughly inspired with the possibilities of Empire development. If you were to study the speeches that have been made on the subject, you would find a noticeable difference between the speeches of those who had merely read what they were talking of and those who had seen it. Horace is often praised for saying, "Caelum non animum mutant qui trans mare currunt." I do not agree with him. Those who go overseas not only change their climate, but a change of mind comes over them. So I hope I carry you with me when I say that for those who can travel everything is more or less easy. As I have said, some have not the opportunity. Thus there arises the question, how can complete knowledge be brought to the greatest number of minds and ears?

You in the Royal Geographical Society have accumulated a great deal of geographical knowledge. I belong to a much-abused body called the British Broadcasting Corporation. While you have the knowledge and those who know, I would like to remind you that we have the power of spreading your knowledge all over the world. What I want to suggest to you to-night, Mr. President, is that although we get a great deal of help from the Society already, a further development of that combination would be a great advantage. We are the megaphone to carry your knowledge to the whole world.

Many adults and children listen to what are called "Travel Talks" by the British Broadcasting Corporation. When they were commenced some years ago those talks were, more or less, similar to the way in which geography was taught when I was young, and when we endeavoured to ascertain what the teachers thought of those talks we were told that generally they were too "informative." Now, thanks to the assistance, I think of one of your Fellows, we have a Committee who decide what the talks should be, and every student who listens has a pamphlet of the subject admirably illustrated; he is shown the kind of life the people live; that is what really matters, to have seen the life and industries of other countries. I dislike the words co-ordination, or co-operation, or correlation; they are generally used by those who do not know what they want. What I

suggest is that we should get together even more closely than now in an endeavour to ascertain what further development can take place.

A somewhat amusing incident took place in connection with one of the broadcast geography talks two years ago. Dr. Stefansson gave a broadcast talk on the Arctic highway, and in the course of his remarks said when he was young he had taught that the North Pole was the coldest place north of the Equator; that vegetation there consisted solely of mosses and lichens, and that the Eskimo lived in houses built of snow bricks. He added that he now knew what the North Pole was really like, and he was obliged to say that all he taught when he was young seemed to be wrong. A father who heard the talk was much impressed, and he repeated it to his son, who was also impressed, and, having to write an essay, he chose the subject of the life of the Eskimo at the North Pole. He wrote down the latest information he had obtained through his father from Dr. Stefansson. His schoolmaster, who happened to be an older and more antique kind of geographer, was much annoyed by the essay and said the matter was all wrong. The boy made an effort to sustain his position and had an argument with the master on the subject. No doubt his style of argument was not as respectful as it should have been, because it ended in the master caning the boy. And that was not the end of the story, because the father took the master to Court for unjustifiable punishment. I do not know what the result of the case was, but it at any rate went to prove that there is some good in the circulation of knowledge through first-rate authorities. In this connection you will remember Dr. Johnson's views on punishment of boys who would not take the trouble to learn: he said that what they lost at one end they gained at the other. In this case, the boy gained in both directions!

I hope you will not mind me grinding my own axe, but I fear I shall never have another opportunity. There is one other connection in which I should like to appeal to the Royal Geographical Society. In some parts of the world the B.B.C. have difficulty in getting messages through owing to atmospherics and seasonal conditions that we have not yet learned to cope with. Your travellers all over the world might perhaps remember those difficulties of ours and ascertain, if they can, what it is that gives rise to them. We are trying very hard, but I am sure we should gain great advantage from your assistance in that connection. I trust you will forgive me for having introduced these topics into the toast of the Royal Geographical Society, but I really think they are germane because we have the necessary elements: the knowledge on one side and the power of spreading it on the other. I want to get those two together.

I have to couple the toast with the name of Admiral Sir William Goodenough, and that I do with very great personal pleasure. When I first acted as First Lord of the Admiralty I met with his great kindness and advice whenever I sought it. He has lived a naval life, which seems to me to be most valuable for the work he is now doing as President of this Society. He was always a cheering friend to me, and I expect he is the same to you. He has great geniality of manner and, what is still more valuable, a sense of perpetual youth about him which makes him want to get on with whatever he has in hand. I believe he is most admirably fitted for the post which he holds, and therefore I ask you to drink his health when honouring the toast of the Royal Geographical Society.

The PRESIDENT, in responding, said: The toast of the Guests is one which belongs to an area which we explore later in the evening, but I am not in any way forestalling the leader of that expedition when I thank Lord Bridgeman very much for coming here and proposing this toast, and Lady Bridgeman, too, for joining us to-night.

It was my privilege some years ago to propose Lord Bridgeman's health, and

I said of him then and of Lady Bridgeman too, as I say with great sincerity now, that their constancy of purpose in all walks of life, whether public or private, is a very great asset to this country. I asked you, Lord Bridgeman, for some thoughts of yours, and you have given us two. You may be quite sure that we will at once get into touch with Sir John Reith, whom we had hoped to see to-night, and his admirable staff, and come to some arrangement whereby we supply the first-hand knowledge and Sir John and his staff will supply what I believe is generally known as broadcasting technique. One of them said to me not long ago, "Even the scientist is not allowed to be dull." We assure you that we will pay the greatest possible attention to all the B.B.C. may tell us, and I am sure that they will get from us that original first-hand knowledge for which you have asked.

You have proposed our health, and I think I may say that our health is good. From the material point of view, for the information of such Fellows as were not at the Annual Meeting this afternoon, we have not a debt in the world. That is a very agreeable position. But I beg Fellows not to think that that means that the Council intends to indulge in an orgy of expenditure. Far from it. Nevertheless, we have no debts and we believe that our reputation stands as high as ever, both abroad and in this country.

There is another reason why our health in the future should be good. It is always pleasant to be the bearer of good news, and this afternoon the meeting elected to succeed me at the end of my term next November, Sir Percy Cox; a proved administrator, a linguist, a traveller, one who has earned, and rightly, the confidence of his fellows, and, more perhaps than anything else, a man of very human sympathies. Under his able presidency we can look forward to a further period of prosperity and progress.

Then there is a loss to which I must refer, namely, Mr. Reeves's retirement. It is not to be supposed that those who are our guests to-night will know so much about him as our Fellows do. The Fellows, especially the older Fellows who have seen Mr. Reeves's fifty-five years of service, given most devotedly to the Society, know that he is a man who now has a European, in fact a world-wide, reputation in all the arts of survey of all kinds. He is the editor of the ninth and tenth editions and the present edition just coming out of that, to us, invaluable book 'Hints to Travellers.' He was President of the Geographical Section of the British Association in 1916, and there are many other activities of his, far too numerous to mention here. It was our hope that he would have been among our guests this evening, so that he might hear what I had to say. Unfortunately, ill-health has overtaken him, but when I go to see him to-morrow to tell him of this evening and this afternoon, I am sure that I shall be able to tell him that this reference to him was received with acclamation. (Hearty applause.)

My predecessors and I, ladies and gentlemen, have followed the practice that in the afternoon we have made some review of the activities of the past year and in the evening have looked to the future. You, Lord Bridgeman, have given us a very good lead as to what we should think of in the future. Visions perhaps. But I am not speaking at all in too large a sense when I put it something like this: What should be the geographer's contribution to the difficulties which are now assailing the world? I hesitate, though I am ready to do so, to use the term World Conference. Recalling its actual name, Monetary and Economic Conference, one might say geography has not much to do with it; but there is more in it than that. There are many of us—I certainly am one—who believe that the geographer's contribution to all those difficulties is that he should find places in the world, hitherto comparatively little known, where the surplus population of the older countries can live in prosperity and happiness, perhaps under entirely new conditions.

It may be that so far as its physical shapes and forms are concerned the world is well known, but its capacity to carry a human population is not known; we have hardly explored the fringes of that subject. Take Australia, for instance, and if you want to read about such questions read those admirable articles on Northern Australia by Sir John Kirwan, who deals with the capacity of that area to carry a population. It may be a repetition of what I said two years ago when I say that one should look to the whole of Southern South America and see what room there is there for millions of people. That, to my mind, is a contribution which we should make. Not only that, but an investigation, in the broadest sense, should be made by geographers in order to ascertain how countries already inhabited can carry a far greater population than they have at this moment.

An interesting publication came out three days ago called *Population*—I can see Captain Pitt-Rivers smiling at being advertised so admirably. But he need not be too pleased. There are many things he publishes and says with which I for one disagree most profoundly. There are however most admirable articles in *Population*, and I draw your attention particularly to one in French, by a Belgian priest, on population, and how he writes that directly things begin to decline they die—that is profoundly true—and of how he says: "The population ages rapidly: it goes rapidly to death." If we as geographers do not endeavour to find, first of all by travel and then by research and investigation, places where the human race can continue to increase and live, we are not doing our duty.

The reward, after all, comes fairly soon. Who would have thought at the time Captain Cook went to Australia that not so very long afterwards—for a couple of hundred years is not very much—the man who, some sixty years ago, unveiled the first statue to Captain Cook in Australia would have been able to say: "With what intense delight would Captain Cook have looked at the comfortable houses and noble buildings which everywhere surround us! Captain Cook was a man of great humanity. With what feelings would he compare the mud-and-wattle cottage in which his father lived with the comfortable cottages which every industrious man in this colony can obtain for himself with fair labour!"

You spoke, Lord Bridgeman, about education in geography. One hundred years ago there was not a single Professor of Geography in this country. Now there are ten. I am not so foolish as to say that that has been brought about by the sole influence of the Royal Geographical Society; at the same time, we have had our share. When you think of the men who have pushed and pressed the teaching of geography forward—men like Douglas Freshfield, Sir Clements Markham, Sir John Scott Keltie, to mention only three—and when you think of material things, and recall that in years gone by our Society has supplied to the Universities something like £20,000 towards the teaching of geography, I think we can say we have done our best.

I would like to add in that connection that some of the younger members of the teaching profession think, no doubt, that we are rather old fogies in the matter of teaching geography. They use the term the New Geography. I saw not long ago in a paper, the name of which I have forgotten, that the Royal Geographical Society, with characteristic intolerance, had paid no attention to what was called the New Geography. I beg that no one will accept that for a moment. We are most desirous, as I said this afternoon, that all younger teachers of geography should realize that many of their institutions have sprung from what we, in the first instance, started, and we are most anxious to forward in every way possible investigations in connection with problems of what is called Human or Regional Geography or things of that kind, not merely with a view to investigating the past but in order that the human race may benefit as a result of progress in geographical matters.

So you see, Lord Bridgeman, you have given us two most admirable ideas, as I felt sure you would do when I asked you to come here.

One word more. If you believe in the good health of this Society being continued, it does want succour from time to time, and I suggest, as I did this afternoon, that new members should constantly join us and assist us to carry on the work which has now been going on for over one hundred years and, we believe, with a genuine desire for advance. Quite apart from other things, we think that new members will get a very good run for their money.

May I again thank you, Lord Bridgeman, for coming here, for proposing our health, and assure you that the oftener you and Lady Bridgeman come to our Society, the more you will be welcomed.

Professor KENNETH MASON, proposing the toast of the Medallists, said: I rise to propose the health of the Gold Medallists and the other recipients of the Society's awards. Year after year we meet together to see in the flesh some of those who have helped to lift the veil that once hid the world from Western eyes. There is in our Book of Common Prayer a canticle which begins: "Oh, all ye works of the Lord, Praise ye the Lord." If we look through the long list of recipients of the Society's awards, we must be struck by the fact that the Council has this canticle before it when it considers its awards. If to some of you this year ice and snow seem to take precedence over fire and heat, I hope you will remember that Africa and Asia have in the past had their share and will have their share again in the future. This is however neither a divinity nor a geography lesson; it is an after-dinner speech, and I think the best I can do is to give you a brief outline of what some of the recipients of the awards have done.

If I were Lord Bridgeman I should probably start straight away by saying, "Hullo, twins!" because the Founder's Medal and the Patron's Medal both go to ice and snow. The Founder's Medal goes to Mr. J. M. Wordie, who has been occupied in Polar exploration from 1914 to the present day. The Patron's Medal goes to Professor Drygalski for his researches in glaciology in the Arctic and the Antarctic. Both Medals have an equal merit, but it is customary in this Society when one of these awards goes to a distinguished foreigner for the proposer to deal with the foreigner first.

Professor Drygalski's devotion to glaciology dates back to when I was about three years old, for he first began to study the glaciers of West Greenland in the early nineties of last century. But throughout his life he has taken a leading part also in Antarctic research. Of the four who led expeditions to Antarctica between 1901 and 1904—Scott, Bruce, Nordenskiöld, and Drygalski—Drygalski is the sole survivor. Before his expedition in the *Gauss* he was frequently in this country consulting with Sir Clements Markham, Sir John Murray, and Dr. Mill, and also with Scott, on the best method of international co-operation in Antarctic exploration. And though Professor Drygalski broke no records farthest South, his ship, the *Gauss*, was the only ship, except the *Belgica*, that has ever passed a winter frozen in the pack-ice off Antarctica without coming to grief; and the *Gauss*, unlike the *Belgica*, retained a fixed position throughout. Professor Drygalski's expedition depended for its reputation on the working out of his scientific observations, and those observations have taken the many specialists twenty years to work out. The Society now takes the earliest opportunity of translating its appreciation into terms of a Gold Medal in order to testify its regard for Professor Drygalski.

Mr. Wordie's first experience of Polar work was with Sir Ernest Shackleton's expedition in the *Endurance*. In Shackleton's book, 'South,' Wordie makes his bow by securing large lumps of biotite granite from a berg which finally brought the ship to grief. When the *Endurance* was fast in the ice and drifting, we read

of Wordie leading an Emperor towards the ship, but we are not told whether he shared his little room "Auld Reekie" with his imperial guest, though it seems probable that the Emperor left in disgust. As you all know, the ship was crushed and the party resolved to make for open water. Wordie was one of the pioneer sledging party; and when they eventually reached Elephant Island he, with twenty-one others, lived in two upturned boats while Shackleton made that amazing journey to South Georgia. We are told that Wordie and the others lived in their boats by the light of two smoky flares "by reading and argument." It seems to me that a place like an upturned boat on an island like Elephant Island would be ideal for a World Economic Conference! No rescue ship need visit the island until an agreement had been reached satisfactory to all.

Wordie reached England in time to go to France with a field battery and to be blown off his horse by a shell. Fortunately it was not a direct hit, and soon after the war we find him back in Polar regions where he was one of the three to make the first ascent of Beerenberg in Jan Mayen in 1921. Two years later, in 1923, and again in 1926, he led Cambridge parties to North-East Greenland, where he repeated Sabine's pendulum observations. In 1929 he led another expedition which climbed Petermann Peak. Wordie at Cambridge is one of those who inspire young explorers to devote their attention to Arctic exploration; he is also on the Committee of the Polar Institute.

It is usual to couple with the toast of The Medallists the names of the other recipients of the Society's awards, and here we note that some of the warmer countries are represented. The mountains of Africa are represented by Dr. Noel Humphreys. Dr. Leakey is rewarded for his observations on climatic change in East Africa. Asia is represented by Miss Freya Stark, who has made journeys in Luristan, and also by my old friend Khan Sahib Mian Afraz Gul Khan, who has made frontier and trans-frontier explorations and surveys in India. I should like to add my personal testimony to the Khan Sahib's work and his unswerving devotion to the cause of geography and exploration. He began his career by enlisting in the Khyber Rifles. He has travelled all over the North-West Frontier, explored and surveyed North-East Persia and parts of Afghanistan, covered much ground in Central Asia, and he probably knows the Karakoram better than any man alive. He has travelled and served with many travellers of distinction, who have the very highest regard for him and for his work.

These are the briefest notes on the men and women we are honouring this evening. All have followed the wise advice of Robert Browning:

> Let things be—not seem;
> I counsel rather—do, and nowise dream.
> Earth's young significance is all to learn:
> The dead Greek lore lies buried in the urn
> Where who seeks fire finds ashes.

May the University of Oxford forgive me these heretical words!

I now ask you to drink to the health of The Medallists and other recipients of the Society's awards, coupled with the names of Professor Erich von Drygalski and Mr. J. M. Wordie.

Professor VON DRYGALSKI, in responding, said: Permit me to thank you heartily for the toast with which you have honoured us. It is now over thirty years since I first received an invitation to attend your Annual Meeting from Sir Clements Markham. It was at the time when Captain F. R. Scott was preparing the *Discovery* Expedition, and myself the *Gauss*. We found a common plan for our geophysical work in the Antarctic, and pursued this happily in combination with the expeditions of W. Bruce, Dr. J. Charcot, and O. Nordenskiöld. Since then

there have been many other expeditions in the Antarctic, by aeroplane too; and England, America, and Norway are continuing the work.

After the great period of exploration of the South Pole about 1840, marked by the brilliant successes of J. C. Ross, M. J. Dumont d'Urville, and C. Wilkes, a second period began at about the turn of the century, since when over twenty large expeditions have been dispatched to the South Pole with great success, such as that of Sir Douglas Mawson. They have opened up the coast of the South Polar continent with the exception of its Pacific side, reached the South Pole, discovered new mountain ranges and volcanoes, explored the inland ice, and probed and found explanations for a number of other natural phenomena on sea and land and in the air. It has become evident that everything there is in close interconnection, the face of the land, the climate, even the living organisms, and that the inland ice is the dominating factor of all.

With this however has come the recognition that this dominating influence extends far beyond the boundaries of the Antarctic, in the currents of the air and the sea, and in all that they carry and in the effects they have; this influence reaches far beyond the Equator to the Northern Hemisphere, where it meets the forces of the Arctic. In our countries indeed we speak of a North Polar Front in the atmosphere, the movements of which affect our climate and cause a good deal of bad weather. There is also a South Polar Front perceptible in the climates of Australia, in the Pamperos of South America, and the Indian Ocean; that is of some importance for navigation between Cape Town and Melbourne. This view, that the polar regions exercise a great influence over all lands and seas, is confirmed by the fact that the Polar Year fifty years ago, in 1882–83, with its eleven northern and two southern stations in high latitudes, has been repeated now in the Polar Year of 1932–33 in all latitudes and with a number of ships and stations belonging to nearly fifty countries. There is no part of the Earth unaffected by the nature of the polar regions. Your present *Discovery* Expeditions are following the life of the whale from South Georgia to Africa, to Australia, and to New Zealand, and are throwing light upon the biological connections between the oceans. In fact, if I were to trace all the influences, I should finally be obliged to speak of the dinner ice that has just refreshed our inner man.

The Royal Geographical Society has always bestowed its attention upon polar exploration. It is therefore a source of great pleasure to us that to-day you have made such honourable mention of these researches, British and German alike. But the Royal Geographical Society, like the North and South Pole, has extended its activities over all the regions of the world. It has itself become a pole for geographical research that makes its influence felt in science as in life. We therefore wish it every success in the future, too; and in Germany as in all other countries we feel ourselves at one with it in its efforts to attain its lofty aim. There will never be any reason to complain of a lack of problems.

Mr. J. M. Wordie also responded and said: I should like to thank the Society on behalf of those others who have received awards and grants for the great honour which you have conferred upon us to-day, and for the kind words with which Professor Mason has given the toast of our healths this evening. Without being invidious, I must pick out from among the recipients of the awards Dr. Leakey's name, because it must surely be unusual that the Society should honour simultaneously two Fellows of the same college. We are both members of the same high table at Cambridge, and at a college which has a very long and honourable tradition in geographical matters. I should like to mention in that connection that our tradition goes back to the distant time when Dr. Dee, the well-known Elizabethan scholar, became interested in the Polar regions and played an important part in sending Captain John Davis to seek for a North-West

Passage. It may be added that Dr. Dee's learning and curiosity for further knowledge led to his being regarded by the general public not as a geographer but as one practising the black art.

The fact that I have been chosen for the award of the Founder's Medal is perhaps largely due to having been the connecting link between the great Antarctic expeditions which were a feature of the pre-war period and the Arctic expeditions on a smaller scale which have been so prominent in the last ten or twelve years. I have certainly tried to bridge the gap. With my friends at Cambridge, Professor Debenham and Mr. Priestley, a nucleus has been formed with the intention, among other things, of preventing any long break ever occurring again in polar tradition in this country. One of the difficulties of Scott's expedition in the *Discovery* in 1901 was that a time interval of more than a generation had intervened between the Franklin search expeditions and the *Discovery* expedition; there was no trained personnel; and it was only Scott's own vigour and knowledge picked up mainly from books which brought him success.

I should like to say how much I am indebted to two favourable factors: firstly, to have served with explorers such as Shackleton and Bruce, and secondly, for the good fortune which found me after the Great War among undergraduates of adventurous disposition. Shackleton was my first master, and there could be no better teacher of the art of exploration than a man who had succeeded as he had in everything he had attempted and who was at the same time so full as he was of poetic imagination and feeling. I should never have felt properly equipped for the Arctic however if I had not also been associated with Dr. W. S. Bruce. I went with him to Spitsbergen in 1919 shortly before he died, and it was from him that I learned the methods and the arts of summer exploration of which Bruce was the master.

Now, indeed, it is becoming almost a commonplace to go to the Arctic in the summer, and each year sees an ever-increasing number of expeditions from both Oxford and Cambridge. No matter how much we are rivals as Universities we are certainly at one in this respect: we are both sending out expeditions to the Arctic, and we join together in helping each other and in giving advice. In the matter of Arctic exploration Oxford and Cambridge are united spiritually and materially. As far as the beginnings of this movement go, I can only speak with certainty of Cambridge; but I know that at Oxford they have great trust in our Honorary Secretary, Dr. Longstaff; and he has just been voted first President of a combined Arctic Club, but by the votes of Cambridge men. As for my own University, you are all probably familiar with Professor Debenham's name; less well known perhaps is the work which Mr. Priestley has done among undergraduates in promoting a knowledge of the Arctic and the Antarctic. For many years he has been giving courses of lectures, and it is from the men attending those lectures that the steady stream of young travellers to the Arctic is drawn. Mr. H. G. Watkins was one of them, and there are many others. I have myself drawn very largely from that source of supply, and I have been unusually fortunate in my companions. When I thank you for the award of the Founder's Medal I do so realizing that all those others who have been with me must also be given the credit. As much for them as for myself I thank you.

Mr. JOHN LODER, proposing the toast of the Guests, said: Mr. President, My Lords, Ladies and Gentlemen: This is one of the occasions when the Royal Geographical Society seeks to show that learning may be profitably turned into convivial channels, though, as a matter of fact, the dinner table is not quite so remote from geography as might appear. I believe gastronomic maps of quite a number of countries have been produced, and although I hardly dare to suggest that we should appoint a permanent committeee on culinary names, there are

certainly some of these names which give spaciousness to the marshalling of the fruits of the Earth in their courses. But if this dinner had no other reason for its existence it would be justified in that it attracts to us distinguished visitors such as those whom we have the honour of welcoming to-night. Those whose exploits have earned them medals and awards have already been dealt with by Professor Mason, but I feel it would not be inappropriate to associate with them one who is present with us, Captain Riiser Larsen, and I think we shall all wish him better fortune in his next endeavour.

Our other guests illustrate the wide appeal which the work of the Society makes and the variety of human activities in which geography has a real and practical meaning. You have already had an opportunity of judging for yourselves what Lord Bridgeman is like. He did not happen to mention that he was a member of the governing body of Eton, which adds considerable point to some of his remarks about the teaching of geography! I have no doubt that he has taken the appropriate steps to see that geography is properly taught at Eton. To me, having associations both with Eton and with politics, Lord Bridgeman is an institution. I hope he will forgive me for using a word which rather suggests venerability, but I do so purely and simply in order to say that while I do not suppose he will witness "a traveller from New Zealand take his stand upon a broken arch of London Bridge to sketch the ruins of St. Paul's," yet we all hope that, like the institution of which Macaulay was then writing, he may long continue "to exist with undiminished vigour."

We have also with us Sir Lynden Macassey, one whose public services it would be impossible for me to enumerate at the present time; but I should like to refer to the fact that he is the Master of the Drapers' Company because it gives me the opportunity of recalling how very much scientific education and research owe to the generosity of the great Livery Companies of the City of London.

Among the various walks of life represented here there is none with which the Society has a closer bond than His Majesty's Forces, and in welcoming Admiral Sir Ernle Chatfield, the First Sea Lord, Admiral of the Fleet Sir Osmond Brook, and General Sir Walter Braithwaite, we shall not only be expressing our regard for those distinguished officers but we shall also be paying a tribute to the tradition of friendly collaboration which has for long existed between the Society and the Army, the Navy, and the Air Force.

The presence of Dr. Spencer Jones, the Astronomer Royal, gives me a further opportunity of drawing attention to cordial relations of very long standing. Now that he is back from the Cape and installed at Greenwich, we can all be sure that the same cordial relations will exist between us as have existed with his predecessors. The terrestrial traveller owes a big debt towards those whose business it is to chart the heavens.

Now I come to a sky pilot of another order, if the Dean of Westminster will forgive me using so flippant a term about some one who by his personality and office is deserving of our highest respect. It is my privilege to couple his name with this toast, and in doing so I should not be accomplishing my duty if I did not make some reference to the part that the Churches have played in bringing into human ken some of the most remote and savage corners of the Earth. In every Continent the pioneers of the Gospel have also been pioneers of exploration, and I feel most fortunate in being able to pay a tribute, which I am sure the Society would like me to pay, to their courage and their devotion.

I am afraid I have committed a very grievous sin in not mentioning any ladies, but I hope and trust that I may be excused because the time is getting on. I cannot however conclude without welcoming all our lady guests, even though I have to do so without mentioning them individually. Ladies and gentlemen,

I ask you to show your appreciation of the presence of so many distinguished visitors here to-night by drinking the health of our guests, coupled with the name of the Dean of Westminster.

The DEAN OF WESTMINSTER, in responding, said: May I first thank Mr. Loder for having paid a tribute to those who have done, in the name of the Church abroad, things that I am sorry to say I have never myself had a share in.

It is perfectly clear to me, Sir, not only why you have chosen me to respond to this toast but why it is quite obvious I am a proper person to do it. Because I am the only one amongst your guests, I suppose, who has achieved no exploit and against whose name there is no creditable entry of any sort or kind. You cannot say that of any of the rest of your guests, and I am painfully conscious of the fact. But then, too, as a brother Dean of mine said in another connection himself, "I am here as a notoriety amongst celebrities."

That being so, I am only going to say two things: First, that there is one more reason why I am obviously the proper person to say something before you separate to-night. I have reflected as I have listened to the speeches that in a peculiar sense I have, or ought to have, the deepest possible sympathy with your Society, because your great problem is my great problem. And while it never occurred to me before, it is plain, I think, that the Royal Geographical Society and the Dean of Westminster are very closely allied and have very much in common. Your principal problem is to find spaces in the Earth where the surplus population may find room—I was going to say may find room to live, but that might spoil the analogy. My constant difficulty too is to find vacant spaces for surplus population—and this in various senses. In the first place, I am always trying to find space for the congregations for which we have not at present room, in the Abbey. Secondly, I am always trying to find spaces where I can put that great population of marble and stone which occupies spaces that living people ought to occupy. And thirdly, I have a dream, a vision, which perhaps may find an echo of sympathy—I think it will—in this room; a dream of something which I fear I shall never accomplish but which I am convinced some successor of mine ought to be enabled to accomplish. There are round the Abbey a series of beautiful chapels which are now full of monuments. I have a dream that some day those chapels may be cleared, at any rate to a large extent, and that we may have at Westminster Abbey, the very heart of the whole English-speaking world, this chapel devoted to India, that to Australia, that to New Zealand, that to Canada, and so on; a chapel for every distant part of the Empire, so that our overseas brethren may have an actual local spiritual home in the Abbey which they already feel is in a sense their home. That being a dream, a vision, I fear, like many dreams and visions, it may not, at any rate in my lifetime, be realized. But I think you will agree now, from what I have said, that the problems before the Royal Geographical Society and before me are very similar.

I have only one other thing to say. One of the interests closest to our hearts at this moment is the Everest Expedition. And as we sit here in all the comfort that we have enjoyed to-night, even the comparative comfort of listening to a series of speeches which is about to come to an end, we must give a thought to those men far away who are representing you and doing the work which is foremost in the objects of this great Society. Above all let us give a kindly thought at this moment to Mr. Hugh Ruttledge, the leader of the expedition. Therefore, ladies and gentlemen, although I may be doing an altogether irregular and improper thing, I would ask you to rise and drink one more toast, and that is to the health and safety and success and prosperity of the Mount Everest Expedition led by Mr. Ruttledge.

The toast having been cordially honoured, the proceedings terminated.

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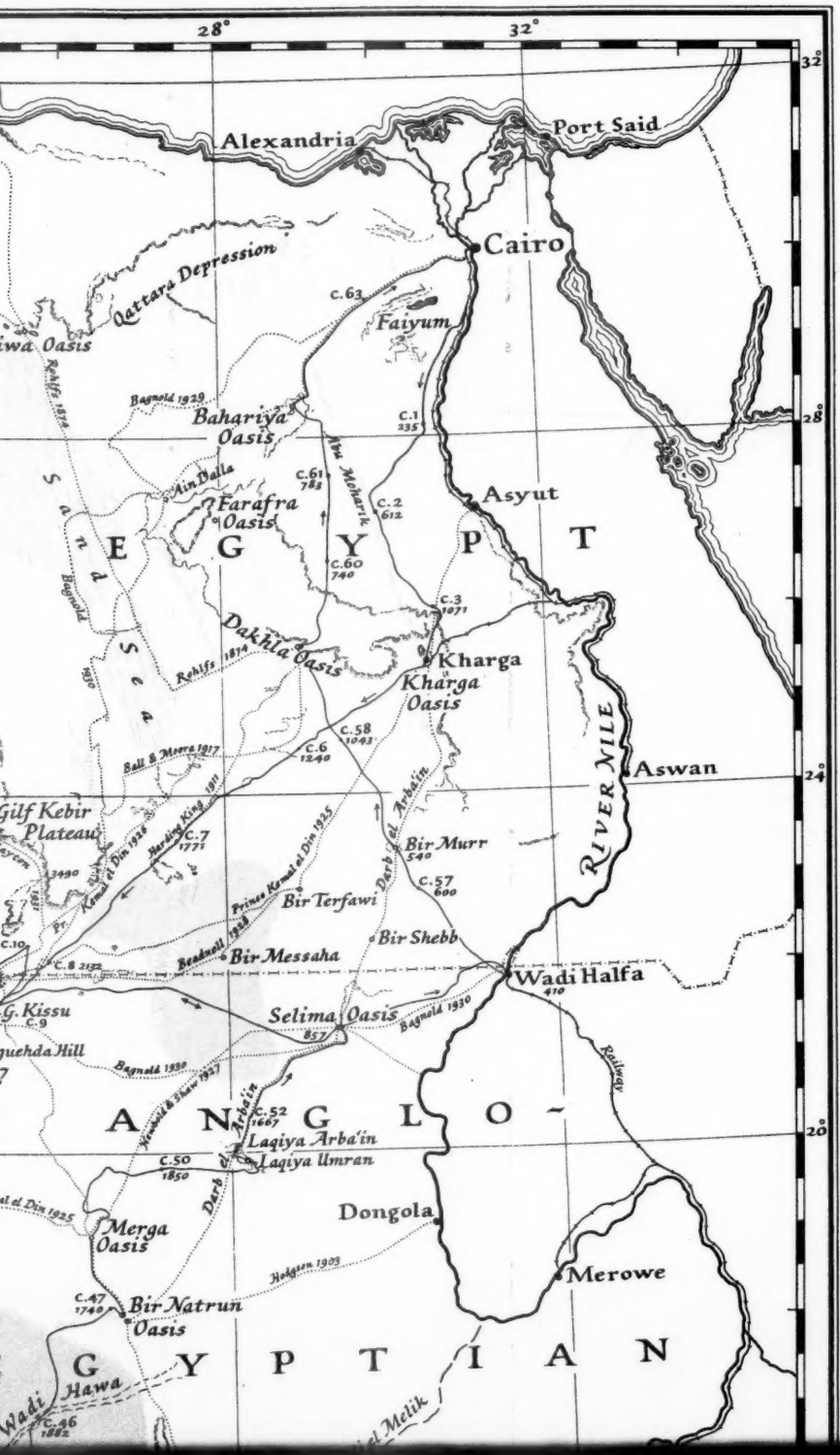

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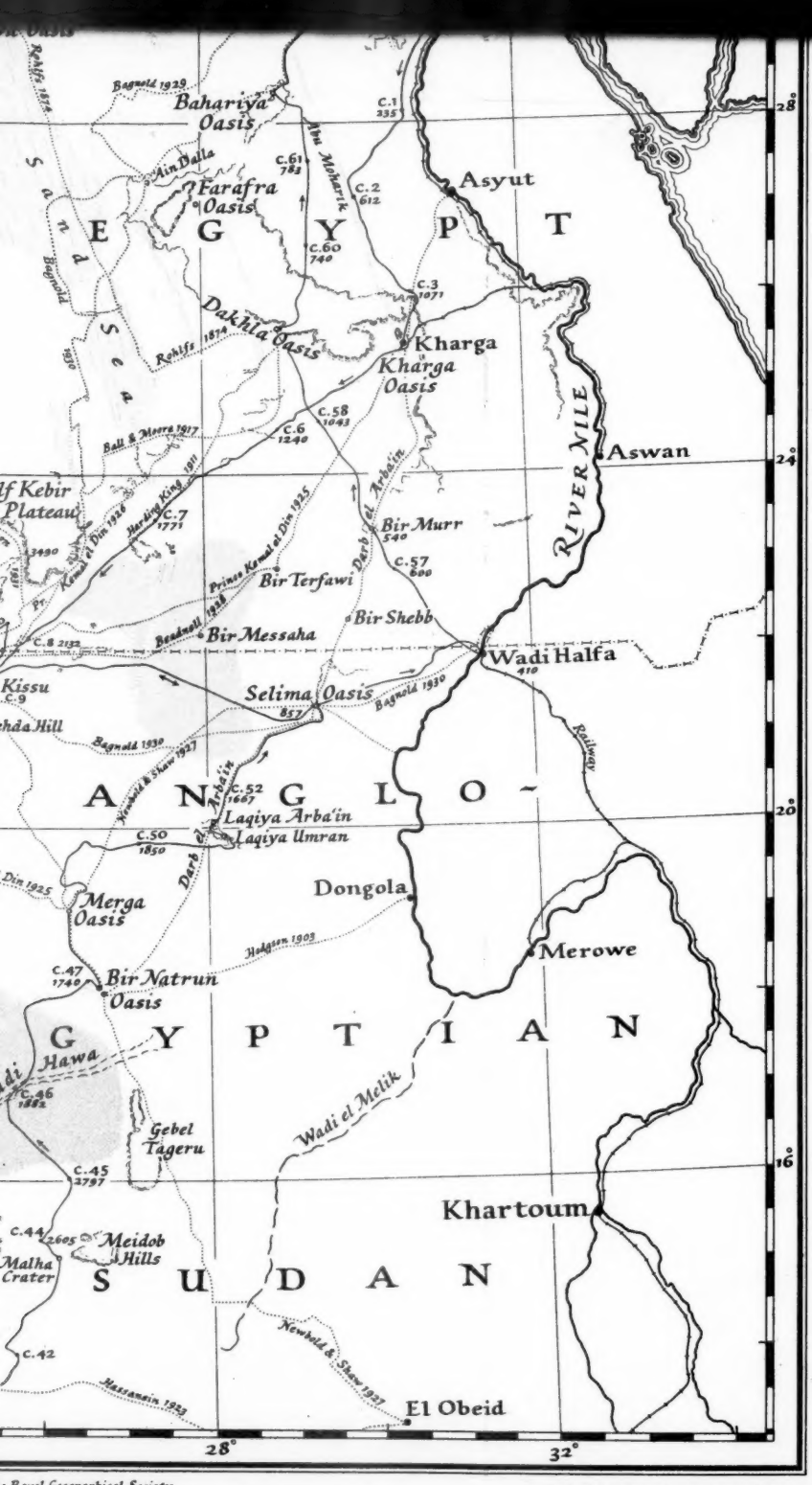

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